OBMUA Sewer Project

LIMITED SITE INVESTIGATION REPORT AND REMEDIAL ACTION WORKPLAN

NJDEP Case No. 07-04-18-1110-28

Laurence Harbor Interceptor Sewer Easement
Block 1 Lot 54.11 & 54.12
Township of Old Bridge
Middlesex County, New Jersey

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EXECUTIVE SUMMARY

Icon Engineering, the Environmental and Geotechnical Division of CME Associates (ICON/CME), has conducted a limited site investigation in the Laurence Harbor interceptor Sewer construction easement located on Lots 54.11 and 54.12 in Block 1 of the Township of Old Bridge, Middlesex County, New Jersey (NJDEP Case No. 07-04-18-1110-28). This work was performed on behalf of the Old Bridge Municipal Utilities Authority (OBMUA) and R3M Engineering inc. pursuant to a Memorandum of Agreement (MOA) between the OBMUA and the New Jersey Department of Environmental Protection (NJDEP), and in accordance with the Bias for Action condition of the Technical Requirements of Site Remediation (NJAC 7:26E-1.11). The site investigation activities were limited to an investigation of fill materials located within a 40-foot wide sanitary sewer construction easement that traverses an approximately 60-acre open space parcel. The OBMUA plans to abandon a falling gravity sewer line that extends from State Highway Route 35 to a Pump Station near Raritan Bay and install a new 30-inch diameter ductile iron pipeline on the site.

The main objective of this site investigation was to characterize the extent and environmental quality of fill materials within the construction easement and specify an appropriate workplan for the remediation of any contaminated soils. The field investigation included twenty-three (23) soil borings and seven (7) test pits. Surficial soils were screened for metal contaminants using an XRF analyzer. A total of eighteen (18) surficial and eight (8) deep discrete fill samples were collected for laboratory analysis. Three (3) existing shallow monitoring wells were sampled to evaluate groundwater quality.

The fill layer in the area of investigation consists of sandy to clayey soil that varies from 7.5 to 15 feet thick. Elevated lead levels were observed in surficial soil samples from 0 to 1-foot bgs along a 400-foot section of the easement between station 6+00 and station 10+00. Lead levels ranged up to 24,000 mg/kg, compared to the most stringent soil cleanup criterion of 400 mg/kg. The lead contaminated soil is typically gravelly sand that comprises the surface of existing dirt roadways and contains varying amounts of battery casing chips. Antimony was also detected at levels exceeding the cleanup criteria. No correlation is evident between the groundwater quality at the site and the surficial soil contamination; lead was below the Class iiA standard in each of the three groundwater samples.

A remedial action workplan is proposed that includes excavation and offsite disposal of the contaminated soil. Post-excavation XRF sampling with laboratory confirmation will be performed to document the effectiveness of the remediation.

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1.0 iNTRODUCTiON

icon Engineering, the Environmental and Geotechnical Division of CME Associates (iCON/CME), has conducted a limited site investigation in the Laurence Harbor interceptor Sewer construction easement located on Lots 54.11 and 54.12 in Block 1 of the Township of Old Bridge, Middlesex County, New Jersey (NJDEP Case No. 07-04-18-1110-28). This work was performed on behalf of the Old Bridge Municipal Utilities Authority (OBMUA) and R3M Engineering inc. pursuant to a Memorandum of Agreement (MOA) between the OBMUA and the New Jersey Department of Environmental Protection (NJDEP), and in accordance with the Bias for Action condition of the Technical Requirements of Site Remediation (NJAC 7:26E-1.11). Pursuant to the Bias for Action, contaminated media should be contained and/or stabilized to prevent exposure to receptors and prevent movement of contaminants through any pathway. in accordance with the MOA the site investigation was limited to an investigation of fill materials located in the sewer construction easement. Additional areas of concern on the site, if any, were not investigated and are not the responsibility of OBMUA.

The site investigation activities were limited to an investigation of fill materials located within a 40-foot wide sanitary sewer construction easement that traverses an approximately 60-acre open space parcel (Figure 1 and Figure 2). The OBMUA plans to abandon a failing gravity sewer line that extends from State Highway Route 35 to a Pump Station near Raritan Bay. A new 30-inch diameter ductile iron pipeline will be installed along a different route.

in April 2007, the New Jersey Department of Environmental Protection (NJDEP) conducted limited soil sampling in order to characterize the fill material on portions of the property (Appendix A). Fill soils that locally included accumulations of shredded battery casings, slag, refractory brick, and other waste materials were locally encountered. Elevated concentrations of lead were detected in fill samples at several locations. The NJDEP issued a Notice of Violation (April 18, 2007) to the Township of Old Bridge, citing violations of the Solid Waste Management Act (NJSA 13:1E-1 et seq.) and the Solid Waste Utility Control Act (NJSA 48:13A-1 et seq.) related to the disposal of solid waste on the property as a fill material in the area of Margaret's Creek.

The main objective of this site investigation was to characterize the extent and environmental quality of fill materials within the construction easement. Based on this information, an appropriate workplan for the remediation of contaminated soils in the sewer line construction easement was prepared.

2.0 PROPERTY DESCRIPTION AND PHYSICAL SETTING

2.1 Location

The 40-foot wide sewer construction easement is ipcated on portions of Lots 54.11 and 54.12 in Block 1 of the Township of Old Bridge ('the site'). The site is located in the Laurence Harbor section of Old Bridge Township, and fronts on Route 35 North (Figure 1 and Figure 2). An existing dirt road extends from a gate on Route 35 northeast toward Raritan Bay. Access is also available through the OBMUA sewage pump station facility located on Boulevard West.

2.2 Topography and Drainage

Based on the Topographic Survey of the Township of Old Bridge (Sheet No. N-3), existing surface elevations along the proposed pipeline route range from approximately 5 to 15 feet msl (NGVD 1988). Elevations in fill areas on the site are locally as high as 28 feet msl. Marquis Creek (a.k.a. Margaret's Creek) is located in the northern portion of the site. Slopes across the easement are generally gentle and oriented to the northwest, north, or northeast. Coastal and freshwater wetlands are present in substantial portions of the site. The Raritan Bay borders the northeast side of the site.

2.3 Geology and Hydrogeology

Surface materials mapped in the project area include estuarine deposits, beach deposits, and artificial fill (Surficial Geology of the Keyport Quadrangle; NJGS OFM 46, 2002; Figure 3). Estuarine deposits are mapped over a majority of the site and are typically comprised of salt marsh sediments including silt and clay, fine sand, and peat. Beach deposits are comprised of sand and pebble gravel, and are mapped along Raritan Bay. Artificial fill is mapped above the marsh deposits in the central western portion of the site, as well as along the dirt road that leads to the beach at Raritan Bay.

Surficial geologic deposits in the project area are underlain by the upper Magothy Formation (Bedrock Geologic Map of Central New Jersey, USGS Map I-2540-B, 1998). The Magothy generally consists of sand interbedded with dark gray clays or silts, and is often characterized by rapid lateral and vertical changes in composition.

3.0 PREVIOUS INVESTIGATIONS

3.1 Site History and Operations

The NJDEP Site Investigation Report (April 18, 2007; Appendix A) includes a review of historical aerial photography of the project site. In a 1930 photograph, the property is dominantly tidal marsh. A dirt road traversed the property from Route 35 northeast to Raritan Bay. Several buildings of unidentified use were located along the beach on Raritan Bay. In a 1974 photograph, fill is evident in an approximately 20 acre area of former marshland in the southwestern portion of the site. Residential developments of single family homes are located to the northwest and southeast of the site. The site is currently vacant and is generally comprised of woodland, marshland, and beachfront. A portion of former marsh area in the northwestern part of the site is now open water. The existing Laurence Harbor Interceptor sewer located on the property is maintained by the OBMUA.

3.2 Environmental Sampling

Three previous investigations have been conducted at the site. In July 2004, a geotechnical investigation was performed by Icon Engineering to characterize the subsurface conditions along the proposed pipeline route. Eight (8) soil borings were performed in the sewer easement. In addition, three (3) monitoring wells were installed to measure shallow groundwater levels. The geotechnical investigation included limited environmental testing of soil and groundwater to provide a preliminary characterization of waste material that might be generated during construction. Two surficial soil samples (0 to 2 feet bgs) were collected and analyzed for priority pollutants (PP+40). All targeted parameter concentrations were below the most stringent soil cleanup criteria (Appendix B). One groundwater sample was collected from each of the three wells, and a single composite sample was analyzed for PP+40. The targeted parameters were either not detected or were detected at concentrations below the New Jersey Class IIA Groundwater Quality Standards (Appendix B).

In April 2005, a limited investigation was performed by Icon Engineering to characterize approximately 200 cubic yards (CY) of soil stockpiled in roughly 40 individual piles in the central portion of the site, to the north of the construction easement. The stockpiled soil was being considered as potential backfill material for the sewer installation project. Six (6) soil samples were collected and analyzed for PP+40. No contaminant concentrations exceeded the most stringent NJDEP soil cleanup criteria (Appendix B).

In December 2006 and March 2007, the NJDEP conducted a limited site Investigation of fill materials on the property. Eleven (11) test pits were excavated to visually characterize the fill material; the test pits were biased to the thickest deposits of fill or to areas with evidence of surficial waste materials. Waste materials observed at several locations In the fill Included shredded automotive battery casings, refractory brick, and slag. In March 2007, sixteen (16) soil samples were collected from the fill layer. Samples L-1 through L-13 were collected in areas of accumulated battery casings and analyzed for lead. Samples S-1 through S-4 were collected in areas where refractory brick, slag, and other waste materials were evident, and analyzed for the complete Target Analyte List/Target Compound List (TAL/TCL). Lead exceeded the non-restricted future use soil cleanup criteria (400 ppm) and the restricted use soil cleanup criteria (600 ppm) in fourteen (14) samples (L-1 through L-13 and S-1). In the samples that exceeded the remedial standards the lead level ranged from 701 ppm to 146,000 ppm, with an average concentration of 50,482 ppm. A copy of the NJDEP Site Investigation Report is provided in Appendix A.

4.0 TECHNICAL OVERVIEW

The scope of work for the site investigation was based on a Limited Site investigation Workplan (May 2007) approved by the NJDEP. The main objective of the investigation was to characterize the composition and environmental quality of fill materials within the 40-foot wide construction easement. This information would then be used to evaluate the need for any remediation that might be required in order to implement the sewer construction project. Sample locations are shown on Figure 4, and a sampling summary for the site investigation is presented in Table 1. Photographs of sample locations are included in Appendix C. Sampling was performed in general accordance with the NJDEP Field Sampling Procedures Manual (August 2005).

4.1 Fill investigation

For the purpose of the investigation, the construction easement is divided into two areas: (1) the main fill area (Station 0+00 to 13+00) and (2) the road/beach area (Station 13+00 to 27+00). The investigation activities were concentrated in the main fill area where historic aerial photos indicate most fill materials on the property were placed. in order to facilitate the field activities, the centeriine of the proposed pipeline was survey located with stations marked at 100-foot intervals.

a. Surficial Soil Sampling: XRF Analysis

Metals concentrations in surficial soil samples were screened in the field using a portable X-Ray Fluorescence (XRF) analyzer in general conformance with EPA Method 6200 (Field Portable XRF Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment). The XRF equipment employed in this investigation was manufactured by innov-X Systems, inc. (Alpha Series). The equipment uses an energy dispersive x-ray fluorescence method to measure elemental concentrations of thirteen (13) different metals (Hg, Sb, As, Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni, Se, and Zn).

Samples from 0 to 6-inches bgs were collected with a decontaminated stainless steel trowel and placed in individual one-quart plastic bags. Larger gravel and organic fragments were removed and the sample was homogenized (soil clumps were broken and the sample was mixed by kneading the plastic bag). The bagged samples were then analyzed, with the sample thickness typically at least one inch. Replicate measurements of selected samples were performed to qualitatively evaluate the precision of the method and to confirm certain readings.

in the main fill area, the surficial soils were screened at stations typically spaced at 100-foot intervals (sample stations B-1 through B-7 and SB-1 through SB-6; Figure 4). At each station, three (3) samples were typically collected: one sample approximately 10-feet to the left of the centerline (sample A), one sample on the centerline (sample B), and one sample 10-feet to the right of the centerline (sample C). Three (3) additional surficial samples were collected in a suspect fill area in an existing dirt roadway (B-4D, B-4E, and B-5D). Additionally, one (1) sample was collected from 6 to 12-inches bgs (B-4E 0.5-1.0').

A total of forty-three (43) surficial soil samples in the main fill area were therefore screened with the XRF analyzer (Table 6). Fifteen (15) of these soil samples (35%) were also analyzed in a laboratory. The samples for laboratory analysis were transferred directly from the XRF bag to laboratory bottles. Six (6) surficial samples were analyzed for TAL metals and TCL base-neutral semi-volatile compounds (SB-1B, SB-2C, SB-3B, SB-4B, SB-5B, and 5B-6C; Table 2). Nine (9) samples were only analyzed for TAL metals in order to provide additional confirmation on the XRF results (Table 3).

in the road/beach area, the surficial soils were screened with the XRF analyzer at approximately 250-foot intervals (samples S-1 through S-3 and S-1A through S-3A; Figure 4; Table 6). At each location, one sample collected along the pipe centerline was screened. Three (3) of the samples were also analyzed in a laboratory for TAL metals (S-1 through S-3; Table 4).

b. Test Pits

Test pits were excavated at seven (7) locations in the main fill area (TP-1 through TP-7; Figure 4). The purpose of the test pits was to evaluate the fill composition, including any larger debris or rubble that may potentially be present in the fill layer. Hill Remediation and Construction Services (Pennington, New Jersey) performed the test pit excavations on May 14, 2007, as directed in the field by iCON/CME. A rubber-tire backhoe was utilized. The depth of the test pits varied between 6 and 12 feet bgs. Test pit logs are included in Appendix D.

c. Soil Borings

Geoprobe direct-push soil borings were performed to evaluate the fill composition and thickness and to collect samples for laboratory analysis (SB-1 through SB-6, GB-1 through GB-5; Figure 4). in the main fill area, sets of soil borings were performed at stations typically spaced at 200-foot intervals (SB-1 through SB-6). At each station, three (3) borings were performed: boring A was located approximately 10-feet to the left of the centerline, boring B was located on the centerline, and boring C was located approximately 10-feet to the right of the centerline. Additional borings were performed to evaluate the fill thickness at selected intermediate locations along the centerline (GB-1 through GB-5). A total of twenty-three (23) soil borings were performed. The borings were advanced until the natural soil profile was encountered, and the depth of the borings ranged from 10 to 20 feet bgs. Boring logs are included in Appendix D.

Hill Remediation and Construction Services (Pennington, New Jersey) performed the soil borings on May 11 and 14, 2007, as directed in the field by iCON/CME. Geoprobe 66DT boring equipment was utilized, with approximately 2-inch diameter soil cores retrieved in 5-foot long dedicated disposable acetate sleeves. All soils were screened for any volatile emissions with a photo-ionization detector (MiniRAE 2000 PiD). Boreholes were backfilled with the soil cuttings.

d. Soil Sampling and Laboratory Analysis

Surficial Soil Sample Collection

Surficial soil samples were collected from the 0 to 6-inch depth interval using a decontaminated stainless steel trowel. All surficial soil samples were initially placed in individual one-quart plastic bags and screened in the field using a portable XRF analyzer (see Section 4,1a above). Larger gravel and organic fragments were removed and the sample was homogenized. Upon completion of the XRF screening, samples for laboratory analysis were transferred directly from the XRF bag to laboratory bottles.

The purpose of the laboratory analysis of surficial soil samples was to:

(1) Characterize typical historic fill contaminants in the upper portion of the fill layer (this may include contaminants associated with specific fill materials as in roadways, as well as contaminants that may have migrated down-gradient from known contaminated areas as a result of erosion and sediment transport); and

(2) Provide confirmation of the XRF results.

in the main fill area, a total of fifteen (15) surficial samples were collected for laboratory analysis. Six (6) surficial samples were analyzed for TAL metals and TCL base-neutral semi-volatile compounds (SB-1B, SB-2C, SB-3B, SB-4B, SB-5B, and SB-6C; Table 2). Nine (9) surficial samples were only analyzed for TAL metals (Table 3).

in the road/beach area, three (3) surficial soil samples were collected for laboratory analysis of TAL metals (S-1 through S-3; Figure 4). Where present, surficial soil samples were biased to areas of suspected contamination (e.g. soil containing battery casing chips).

Deep Soil Sample Collection

Deeper samples in the main fill area were collected from the Geoprobe soil borings (see Section 4.1c above). A total of eight (8) soil samples were collected from the fill layer at depths that varied between 1.5 and 9-feet bgs. Discrete samples were collected from 6-inch intervals and transferred directly from the boring sleeves to laboratory bottles. Samples were biased to possible indications of contamination, if any. Where distinctly different types of fill soils were present, discrete samples of each type were collected.

The purpose of the laboratory analysis of the deeper samples was to characterize potential contamination in the different fill types placed on the site. Each sample was analyzed for the full Target Compound List (TCL) and Target Analyte List (TAL) contaminants (Table 2).

4.2 Groundwater Sampling

a. Monitoring Wells

in July 2004, three (3) groundwater monitoring wells were installed in or immediately adjacent to the sewer construction easement (MW1, MW2, MW3; Figure 4). The purpose of the wells was to measure shallow water levels and collect information needed to evaluate dewatering requirements for the proposed pipeline installation. Each well consists of 4-inch diameter PVC casing installed in an approximately 10-inch diameter auger borehole. The nominal well depths are 20 feet (MW1) and 15 feet (MW2 and MW3). The lower 10 feet of each well was screened with prefabricated 10-slot (0.010-inch) PVC screen. The wells were generally screened in the silty marsh deposits in which much of the pipeline excavation is expected to occur. A filter pack of No. 1 quartz sand was placed between the PVC screen and the borehole wall, from the bottom of the borehole to approximately 1 foot above the top of the screen. An approximately 1-foot thick bentonite seal was installed above the filter pack, and the portion of the borehole above the seal was backfilled with drill cuttings. A stick-up steel outer casing and concrete cap was installed at the top of each well. As-built well construction details are presented in Appendix E. The wells were initially developed at the time of installation as well as during pump tests conducted in July 2004. On May 3, 2007, the wells were re-developed using a submersible pump.

b. Sample Collection and Laboratory Analysis

in order to obtain an assessment of groundwater quality along the construction easement, the existing wells MW-1, MW-2, and MW-3 were sampled on May 17 and 18, 2007. Static water levels were measured with an electronic water probe. A peristaltic pump and dedicated disposable polyethylene tubing was used to purge the wells, with the pump intake set approximately midway in the pre-purge static water column. Water quality indicator parameters including temperature, pH, conductivity, turbidity, and salinity were monitored during purging using a multi-parameter water quality meter (Horiba U22). Monitoring well field sampling forms are included in Appendix F. After a sufficient water volume was removed, the pump rate was reduced to a low flow condition (~0.5 l/min). Samples were collected after the water quality parameters had stabilized at low flow. Samples for metals analysis were collected first by transferring the pump outflow directly into laboratory bottles. Samples for volatile organics analysis were then collected using dedicated disposable Teflon bailers. Samples were transferred in the field to laboratory bottles with appropriate preservative as required. Samples from each well were analyzed for TCL volatile organic compounds (TCL VO+10) and for TAL metals.

4.3 Quality Assurance

The data quality objective for the limited site investigation was to provide an initial characterization of the historic fill materials present in the sewer construction easement. The investigation included the collection and laboratory analysis of soil and groundwater samples as described in previous sections. Quality assurance protocol included the following:

- All sample bottles were stored in a cooler with ice packs and delivered to a New Jersey certified laboratory with proper chain-of-custody (Hampton-Clarke, inc. Veritech Laboratories; NJEP Certification No. 14622).
- Sample containers of sufficient volume for the specified target parameters were provided by the laboratory, including appropriate sample preservatives where required. Samples were submitted to the laboratory within 48 hours of collection. All sample holding times for the specified analyses were in conformance with the NJDEP Field Sampling Procedures Manual (August 2005).
- Non-aqueous laboratory samples were analyzed using EPA specified methods (Test Methods for Evaluating Solid Waste, SW-846, Third Edition); aqueous samples were analyzed using appropriate methods, including EPA SW-846, 40 CFR Part 136, and the Method for the Chemical Analysis of Water and Wastes (EPA 600/4-79-020).

- Laboratory results are in a Reduced Laboratory Data Deliverable format that complies with NJAC 7:26E-2.1. Laboratory non-conformance summaries are Included in the reduced deliverable reports.
- Reporting Limits (RL) for target analytes for EPA SW846 methods are reported to the Practical Quantitation Limit (PQL).
- The applicable remediation standards used to evaluate the soil analytical results are the NJDEP Soil Cleanup Criteria (last revised May 12, 1999). RL that exceed the unrestricted use SCC for individual target contaminants are indicated in the analytical result summary tables.
- The applicable remediation standards used to evaluate the surface water analytical results are the Ground Water Quality Standards (NJAC 7:9C). RL that exceed the applicable groundwater quality standards for individual target contaminants are indicated in the analytical result summary tables.
- Dedicated disposable sampling equipment was used where possible (e.g., Geoprobe acetate sleeves, polyethylene and silicon pump tubing).
- Soil samples for volatile organics analysis were collected in individual 25-gram EnCore type samplers.
- Reusable sampling equipment (e.g., stainless steel trowels) were decontaminated in the field using the following procedure: (1) removal of heavy soil; (2) scrub with Alconox detergent solution; (3) rinse with distilled water and air dry; and (4) rinse with 5% acetic acid solution and air dry.
- One field blank sample was collected to confirm the decontamination procedure. In the field during the sampling activities, laboratory provided de-ionized water was run over decontaminated sampling equipment (e.g. stainless steel trowel) directly into lab bottles. The field blank sample was analyzed for the same parameters as the soil samples (TCL VO+10, BNA+25, and TAL metals).
- Trip blanks accompanied the laboratory bottle shipments for each aqueous sampling event (Trip Blank 5-11-07 and Trip Blank 5-18-07). The trip blanks were analyzed for volatile organic compounds (VO+10).

5.0 SITE INVESTIGATION FINDINGS

Sample analytical results with comparison to the applicable remediation standards are summarized in Table 2 through Table 5. XRF results are summarized in Table 6. Soil boring and test pit logs are included in Appendix D. Laboratory summary reports are included as Appendix G, and the Reduced Data Delivery Reports are included as Attachment A.

5.1 Extent and Composition of Fill Layer

The approximate vertical limit of the fill layer is shown in a cross-section along the proposed pipeline (Figure 5). The thickness of the fill layer within the area of investigation varies from about 7.5 to 15 feet. The elevation of the base of the fill layer varies from +5 to -5 feet msl.

The following observations regarding the fill composition are noted:

- The fill material encountered in the investigation consists of soils varying from brownish yellow sand to dark gray clay.
- The surficial fill in and adjacent to the roadway area from station 7+00 to station 9+00 is typically fine to medium sand with little gravel and little silt; the gravel fraction includes quartz pebbles, brick fragments, and black plastic battery casing chips. The battery casing chips are most abundant in the upper 6-inches and are consistent with the material present in other areas of the site that were previously investigated by the NJDEP (Appendix A).
- Buried rubble and debris consisting of concrete, wood, and a rubber tire was encountered at one location in the fill layer (TP-6).
- No elevated PID readings or odors indicative of contamination were observed in the fill layer.
- The undisturbed natural soil profile directly beneath the fill layer is variable, and includes mottled gray and yellowish brown silt with little sand, soft dark gray organic silt with little peat, and stiff dark gray clay and silt.

5.2 Environmental Quality of Fill Materials

The analytical results for both the XRF field screening and laboratory soil testing are compared to the New Jersey Soil Cleanup Criteria (SCC; last revised May 12, 1999). The laboratory results for soil analyses are summarized in Table 2 through Table 4. XRF results are summarized in Table 6. Samples with detected contaminants that exceed the SCC are indicated in Figure 6.

Based on both the XRF and the laboratory analyses, the following observations regarding contamination in the fill soils are noted:

- Elevated lead levels were observed in surficial soil samples from station 7+00 to station 9+00. Lead levels ranged up to 24,000 mg/kg (Sample B-4E), compared to the direct contact soil cleanup criterion of 400 mg/kg for residential use and 600 mg/kg for non-residential use. The samples with high lead levels corresponded to the sandy soils that contained trace amounts of battery casing chips.
- The antimony level was elevated in the surficial soil sample at location B-4E. Antimony was detected at 110 mg/kg, compared to the most stringent SCC of 14 mg/kg.
- The metals contamination appears to be limited to surficial soils. The highest laboratory confirmed lead concentration in the easement was 24,000 mg/kg at sample location B-4E from 0 to 6-inches bgs. The lead concentration was 610 mg/kg in a sample from 6 to 12-inches bgs at the same location. Antimony and arsenic levels were below the SCC in this sample. The targeted metal levels in deeper fill soils throughout the area of investigation were generally below the most stringent SCC; a slightly elevated arsenic level in one sample may reflect a naturally occurring condition.
- Arsenic was detected at 23 mg/kg in a sample from 8.5 to 9.0 feet bgs at location SB-4C. The most stringent SCC for arsenic is 20 mg/kg. The slightly elevated arsenic concentration in this sample is likely naturally occurring due to the presence of regraded silty marsh soils in the fill layer.
- The XRF results for lead, the main contaminant of concern at the site, were generally consistent with the analytical laboratory confirmation results (Table 7). The XRF results compared less favorably for other potential metal contaminants, including mercury, cadmium, and arsenic. Based on the laboratory results, these metals are not contaminants of concern at the site.
- No surficial or deep contamination in the fill layer is indicated from pipeline station 0+00 through station 6+00.

- No surficial or deep contamination in the fill area Is indicated from pipeline station 10+00 through station 13+00.
- No surficial contamination is indicated in the road/beach area from pipeline station 13+00 through station 27+00.

The lead and antimony contamination appears to be restricted to surficial soils in a limited area of the construction easement. The contaminated area extends from some point prior to pipeline station 7+00 to some point after station 9+00, and is near the intersection of two existing dirt roads. The lead contaminated soil Is typically gravelly sand that comprises the road surface and contains varying amounts of battery casing chips. Elevated lead levels are commonly associated with soils containing crushed battery debris. The battery chips may have been placed as a type of gravel to stabilize portions of the roadway, or may have been tracked along the roadway from a source area. More abundant battery chips are evident at the surface along the main site roadway near the Route 35 site entrance, in one of the areas previously investigated by the NJDEP. In that area of the site, lead levels as high as 106,000 mg/kg were reported in surface soils. Regardless of how the contamination originated, the lead contamination in the pipeline easement appears to be a surficial problem and does not significantly extend below a depth of about 1-foot bgs. In the area of investigation, no battery casing debris was observed below the upper one foot of soil.

5.3 Groundwater Quality

Groundwater sampling results are summarized in Table 5 with comparison to the Class IIA Groundwater Quality Standards (GWQS; NJAC 7:9C). Contaminants that exceed the Class IIA are Indicated in Figure 7. The following observations regarding groundwater quality at the site:

- In the MW-1 sample, iron and manganese exceeded the GWQS. Additionally, the field measured pH was low.
- In the MW-2 sample, aluminum, arsenic, beryllium, iron, manganese, and sodium exceeded the GWQS. Additionally, the field measured pH was low.
- In the MW-3 sample, Iron and manganese exceeded the GWQS. Additionally, the field measured pH was low.

No correlation Is evident between the groundwater quality and the surficial soil contamination that is locally present in the easement or In other areas of the site. The primary contaminant of concern at the site is lead, and lead was below the Class IIA standard in each of the three wells. The groundwater quality at the site, particularly In the MW-2 area, likely reflects the marsh conditions. The MW-2 well is screened in naturally acid-producing organic silt marsh deposits that were locally disturbed and aerated by the well installation. Regardless, due to the site location adjacent to the saline waters of Raritan Bay, the shallow groundwater at the site is likely not suitable for potable use. The actual classification for the site groundwater would likely be Class III.

6.0 REMEDIAL ACTION WORKPLAN

6.1 Remedial Action Selection

Contaminated fill material is present within limited portions of the sewer construction easement. Upon excavation the contaminated soil would become a regulated waste material and must be appropriately managed as such. The remediation of the contaminated fill material within the construction easement will thus be coordinated with the sewer construction activities. Due to the apparent limited extent of contamination in the easement, excavation and offsite disposal of the contaminated fill is a feasible remedial approach. The remedial activities should be completed prior to the initiation of pipeline construction in this area of the easement. Any contaminated areas outside the construction easement are not the responsibility of the OBMUA and are not addressed in this workplan.

6.2 Contaminants of Concern and Remedial Standards

The site investigation findings indicate that contaminated soil is only present in a limited section of the construction easement and appears to be surficial. Based on the laboratory analytical results, the contaminants of concern are metals including lead, antimony, arsenic, and chromium. Each of these metals was detected at concentrations that exceed the most restrictive soil remediation standards. The applicable remediation standards for this project are the New Jersey Residential Direct Contact Soil Cleanup Criteria (RDCSCC; last revised May 12, 1999) as follows:

Parameter	RDCSCC (mg/kg)
lead	400
antimony	14
arsenic	20
hexavalent chromium	240*

*Non-Residential SCC for hexavalent chromium is 20 mg/kg

6.3 Excavation Limits

Based on the verified clean locations as indicated by the available laboratory analytical data, the maximum longitudinal extent of soil contamination extends from station 6+00 to station 10+00 (Figure 8). A full delineation was not performed, so the cpntamination is assumed to extend laterally through the full 40-foot width of the easement. Based on the limited vertical delineation sampling within this area of the easement, the vertical extent of contamination is assumed to extend to 1-foot bgs. Thus, the maximum estimated volume of contaminated soil is approximately 600 cubic yards (CY). Based on the XRF field screening, the limits of the excavation may be modified (increased or decreased) at the time of remediation.

6.4 Restricted Access Areas

The lateral extent of contamination outside the 40-foot wide construction easement has not been delineated. Site access during remedial and construction activities will therefore be restricted in order to avoid the disturbance of potentially contaminated soils outside the immediate remediation area. The remediation area, staging area, ahd construction access road are indicated on the soil remediation plan (Figure 8). Appropriate safety fencing will be installed at the limit of the remediation area in order to provide a visual and physical barrier that will prevent disturbance outside the remediation area.

Additionally, access to known contaminated areas sampled by the NJDEP will be restricted in order prevent the spreading of contaminated soils. in particular, access along the main site road that extends from the existing gate at Route 35 will be prohibited during the remediation and subsequent pipeline construction activities.

6.5 Post-Excavation Sampling

Post-excavation sampling is required to confirm the effectiveness of the remedial action. The post-excavation sampling may be performed in the field using XRF equipment, with limited laboratory confirmation analyses. Laboratory confirmation of the contaminants of concern will be performed on at least 10 percent of the post-excavation samples with a minimum of two laboratory samples. The laboratory samples will be biased to the soil with the highest XRF contaminant concentrations.

Post-excavation bottom samples with the XRF will be performed at a minimum frequency of one (1) sample per nine-hundred (900) square feet of excavation area. Based on the assumed remedial area of 16,000 square feet, approximately eighteen (18) post-excavation bottom samples will be analyzed with XRF; at least two (2) samples will be delivered to a State certified laboratory for analytical confirmation of the lead, antimony, arsenic, and hexavalent chromium concentration. Additionally, three (3) post-excavation samples will be collected along each longitudinal edge of the excavation (i.e., at station 6+00 and station 10+00). One (1) sample from each edge will be delivered to a State certified laboratory for analytical confirmation of the lead, antimony, arsenic, and hexavalent chromium concentration. Thus, for the assumed excavation area, a total of twenty-four (24) post-excavation XRF samples are proposed, of which four (4) will also be laboratory analyzed. Post-excavation samples will be biased to any areas containing battery casing chips.

6.6 Stockpile and Waste Classification Testing

Excavated contaminated soils will be placed in a temporary stockpile area pending waste classification testing (**Figure 8**). Stockpiled soil will be placed on, and covered with, 10-mil plastic sheeting (or equivalent tarpaulin) that will be secured to prevent wind displacement. Silt fence will be installed around the perimeter of the stockpile area for soil erosion control. An appropriate number of waste classification samples shall be collected for analysis of RCRA characteristics including a full Toxicity Characteristic Leachate Procedure (TCLP). At the completion of the remediation, all plastic sheeting will be properly disposed as contaminated material.

6.7 Dust Control

Due to the locally high lead levels in the soil, airborne dust monitoring shall be performed during remedial activities. Dust monitoring will be performed using a particulate meter (TSI DustTrak Aerosol Monitor; MIE pDR-4000 Data Ram; or equivalent) to ensure that dust concentrations are acceptable. Dust monitoring will be performed at least hourly in work area locations and at the downwind site boundary. The monitoring frequency may be increased based on conditions in the work areas. Site specific action levels for the dust monitoring are defined in the Health and Safety Plan (**Attachment B**). Dust suppression procedures will include wetting the ground surface or source of dust. A water truck or equivalent source will be maintained onsite for this purpose.

6.8 Construction Staging, Storage, and Access Areas

Construction storage and staging areas, and haul roads have been situated outside of known contaminated zones (**Figure 8**). The construction entrance and tracking pad will be located at the northern site entrance from Route 35 (use of the existing main site road to the south is prohibited due to surficial soil contamination).

6.9 Decontamination

A vehicle tracking pad and equipment decontamination zone will be setup at the boundary of the remediation area (**Figure 8**). The tracking pad will be comprised of clean stone placed over a suitable geotextile. Equipment will be steam cleaned upon leaving the remediation area. A temporary decontamination water collection system will be installed, including an impermeable base. Decontamination water will be collected and disposed offsite at an appropriate facility. At the end of the remediation, the tracking pad material will be collected and disposed as contaminated material. A personnel decontamination zone will also be setup at the boundary of the remediation area, including a wash station and drums for disposable personal protective equipment.

6.10 Post-Remedial Construction Monitoring

Following completion of the soil remedial action, installation of the pipeline throughout its length will be monitored for any indication of contamination or buried debris, including but not limited to battery casing debris. Dust monitoring should also be performed during the main pipeline installation.

6.11 Restoration

The remediation area will be fully restored following installation of the pipeline. The remedial excavation will be backfilled with certified clean soil; grass seed will be planted to stabilize the disturbed areas.

6.12 Permitting

The Soil Erosion and Sediment Control Plan will be revised and submitted to the Freehold Soil Conservation District for certification. The soil remedial action will be performed under the existing Waterfront Development Permit and approval for the pipeline project. Because some parameters exceed the groundwater quality standards, a Permit-by-Rule will be acquired for the return of any groundwater removed during dewatering of the pipeline construction trenches.

6.13 Groundwater Management

Groundwater is not expected to be encountered during the remedial activities, in which the excavation will only extend to approximately 1-foot bgs. Groundwater dewatering is expected to be required during installation of the pipeline. Water should be disposed outside of known contaminated areas. A Permit by Rule should be obtained for dewatering disposal.

6.14 Health and Safety

A site specific Health and Safety Plan (HASP) for remedial activities associated with the sewer construction has been prepared in accordance with applicable standards (NJAC 7:26E-1.9; 29 CFR 1910 & 29 CFR 1926; Attachment B). The HASP addresses potential job hazards specifically related to the handling of contaminated soils, and specifies minimum safety training requirements, safety responsibilities, control measures, monitoring requirements, appropriate personnel protective equipment, decontamination procedures, and emergency procedures. The HASP will be applicable to all personnel working at the site, and will supplement individual contractor's health and safety plans for specific activities as well as industry safety standards. Prior to mobilization, copies of the HASP will be provided to all construction contractors, consultants, and any other field personnel.

6.15 Schedule

The remediation will be performed prior to the main pipeline construction, and is expected to begin by October 1, 2007. The remediation, including setup, excavation, and soil disposal, is expected to be completed in approximately four (4) weeks, and should thus be completed by November 1, 2007.

PHASE IA CULTURAL RESOURCES SURVEY
LAURENCE HARBOR INTERCEPTOR
OLD BRIDGE TOWNSHIP
MIDDLESEX COUNTY, NEW JERSEY

FEBRUARY 2005

RICHARD GRUBB & ASSOCIATES, INC.
Cultural Resource Consultants

Phase IA Cultural Resources Survey
Laurence Harbor Interceptor
Old Bridge Township
Middlesex County, New Jersey

By

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Principal Investigator:

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Date:

February 10, 2005

SECTION 1.0 EXECUTIVE SUMMARY

The purpose of this Phase IA cultural resources survey was to assess the probability for significant archaeological resources within the Area of Potential Effects (APE) for the proposed Laurence Harbor Interceptor in Old Bridge Township, Middlesex County, New Jersey. The survey was performed to complete a requirement of a Coastal Area Facility Review Act permit application for the New Jersey Department of Environmental Protection.

The primary goal of this Phase IA survey was to identify whether the APE has sensitivity for significant historic or prehistoric archaeological resources. Background research indicated that two registered prehistoric sites (28-Mi-19 and 28-Mi-20) lie within or in immediate proximity to the APE. A site visit revealed that the APE traversed well-drained landforms and wetlands near the Raritan Bay. Based on the proximity of the two registered prehistoric sites, there is a high likelihood for prehistoric archaeological resources within the APE. The historic archaeological sensitivity is considered moderate to high because of the potential for a rail-line associated with the New York and Long Branch Railroad, or another late-nineteenth-century transportation-related resource, in or near the APE.

It is the recommendation of Richard Grubb & Associates that a Phase IB cultural resources survey be performed. For prehistoric resources, systematic shovel testing is recommended in the upland sections of the APE. Additional historical research of an unidentified embankment (i.e. the possible rail-line or transportation-related feature) in or near the APE should also be conducted as part of the Phase IB survey to clarify the history, nature, and function of this potential resource. If the embankment is found to represent a late-nineteenth-century transportation corridor, archaeological testing will be conducted recommended to assess its potential significance.

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SECTION 4.0 INTRODUCTION

The following report presents the results of a Phase IA cultural resources survey conducted in Old Bridge Township, Middlesex County, New Jersey (Figures 1-2). The survey was performed by Richard Grubb & Associates, Cranbury, New Jersey for R3M Engineering, Old Bridge, New Jersey, consultant to the Old Bridge Municipal Utilities Authority. The scope of work for the project was limited to an intensive program of background research, a site visit, a probability assessment, and the formulation of management recommendations.

The Old Bridge Municipal Utilities Authority has determined that the existing gravity pipe to the pump station on Boulevard West in Laurence Harbor has partial failures and needs to be replaced. A temporary high-density polyethylene pipe has been laid on the ground surface as an emergency back-up in the event of a catastrophic failure of the existing gravity pipe (see Attachment). The proposed Laurence Harbor Interceptor Sewer would replace the damaged gravity pipe. The APE includes those areas to be impacted by the construction of the interceptor sewer and the meter chamber (see Attachment). The proposed 30-inch interceptor sewer extends for approximately 2600 linear feet. The interceptor sewer will be placed between 10 feet and 19 feet below the ground surface with an average depth of 13 feet. The deepest area of pipe excavation will be near the pump station. The sewer alignment begins at a manhole on the northeast side of Route 34 and extends through woods and coastal grasses to the existing pump station near Boulevard West. It is anticipated that the interceptor will be constructed using trench boxes and sheeting to minimize the trench width and subsequent land disturbance. The proposed metering chamber will be a 21-foot by 13-foot underground concrete structure adjacent to the existing pump station at the northwestern end of the interceptor sewer alignment.

The Phase IA cultural resources survey was performed to comply with the requirements of a Coastal Area Facility Review Act permit application (New Jersey Public Law, 1973, Chapter 185, Sections C.13:19-5 to 19-7). The law requires that an application for a permit must include an environmental impact statement evaluating the effects of a proposed project in a coastal area on existing environmental conditions, including cultural resources at the project site and surrounding region. The project falls under the review authority of the Historic Preservation Office (HPO), New Jersey Department of Environmental Protection. Copies of this report and all field notes, photographs, and project maps are on file at the office of Richard Grubb & Associates, Cranbury, New Jersey.

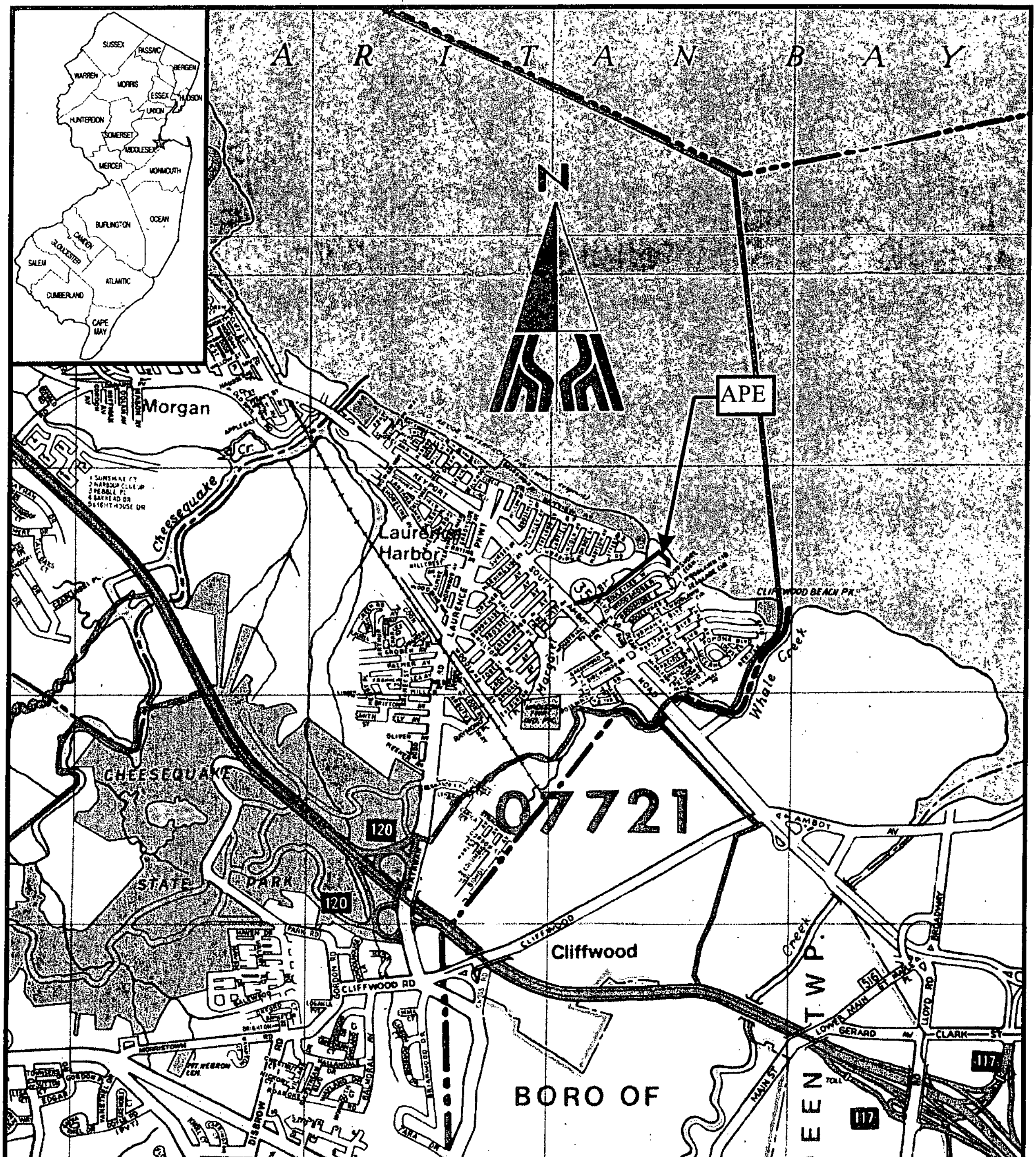

Figure 1:

Project Location (from 2001 Hagstrom Map Company, Inc., Street Map of Middlesex County, New Jersey).

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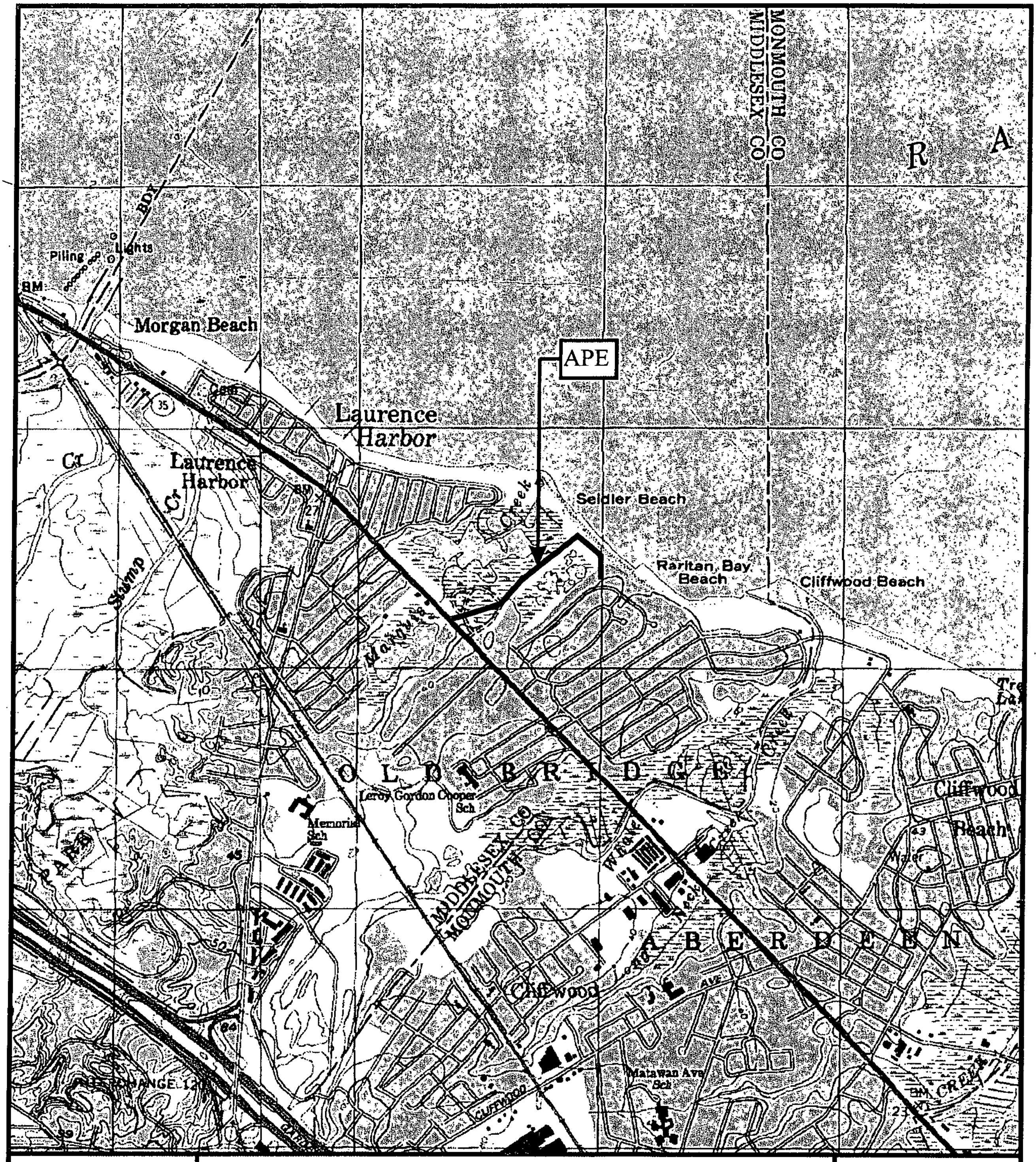

Figure 2:

Project Location (from U.S.G.S. 7.5' Quadrangles: Keyport, NJ-NY 1995 and South Amboy, NJ-NY 1995).

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SECTION 5.0 DESCRIPTION OF THE AREA OF POTENTIAL EFFECTS

5.1 Area of Potential Effects

The APE is located in an undeveloped part of Old Bridge Township northeast of Route 35 and northwest of a residential subdivision (see Attachment). The proposed interceptor sewer begins at a manhole (Station 0+00) on the northeast side of Route 34 and extends 253 feet northeast paralleling the temporary above ground high-density polyethylene pipe. The alignment turns east and extends for 576 feet crossing the temporary high-density above ground polyethylene pipe to an existing dirt road. The alignment extends along the southeastem side of a dirt road for 400 feet. The alignment shifts to the center of the dirt road for 845 feet continuing towards the Raritan Bay shoreline. The road and the alignment cross a small culvert. The alignment makes a 90° tum towards the southeast paralleling the Raritan Bay shoreline for 360 feet. The alignment turns south towards the pump station for 142 feet where the meter chamber is proposed. The interceptor sewer leaves the meter chamber extending for approximately 60 feet before tuming east into the pump station compound. The proposed meter chamber, a 21-foot by 13-foot underground concrete stmcture, will be located on the westem side of the existing pump station facility (see Attachment).

A twentieth-century development is located southeast of the APE. The Raritan Bay is located northeast of the APE. The Marquis Creek and salt-marshes are located northwest of the APE. Route 35 is located southwest of the APE. The proposed project falls in one of the few undeveloped sections of Old Bridge Township. The proposed interceptor sewer and meter chamber are primarily located in a low-lying setting traversing wetlands and well-drained landforms. Elevation of the APE ranges from 6-15 feet above mean sea level.

5.2 Environmental Setting

The APE is located in the Inner Coastal Plain Physiographic Province of New Jersey (Wolfe 1977; Figure 3). Sediments underlying the Inner Coastal Plain are both marine and continental in origin and generally consist of unconsolidated clay, silt, sand, marl, and gravel deposited during the Late Cretaceous and Tertiary geological time periods (Wolfe 1977). The Late Cretaceous-Early Tertiary marine deposits are stratified in beds gently dipping southeastward. The APE is underlain by quartz, sand, and gravel inter-bedded with clays and silts associated with the Upper Cretaceous Magothy Formation (Owens et al. 1998). Along the Raritan Bay shoreline, the surficial sediments are mapped as Holocene Beach deposits (Newell et al. 2000). The surficial sediments in the low-lying portion of the APE and set back from the shoreline are mapped as Holocene to Pleistocene salt-marsh deposits consisting of organic muck and peat, silt, clay and sand (Newell et al. 2000).

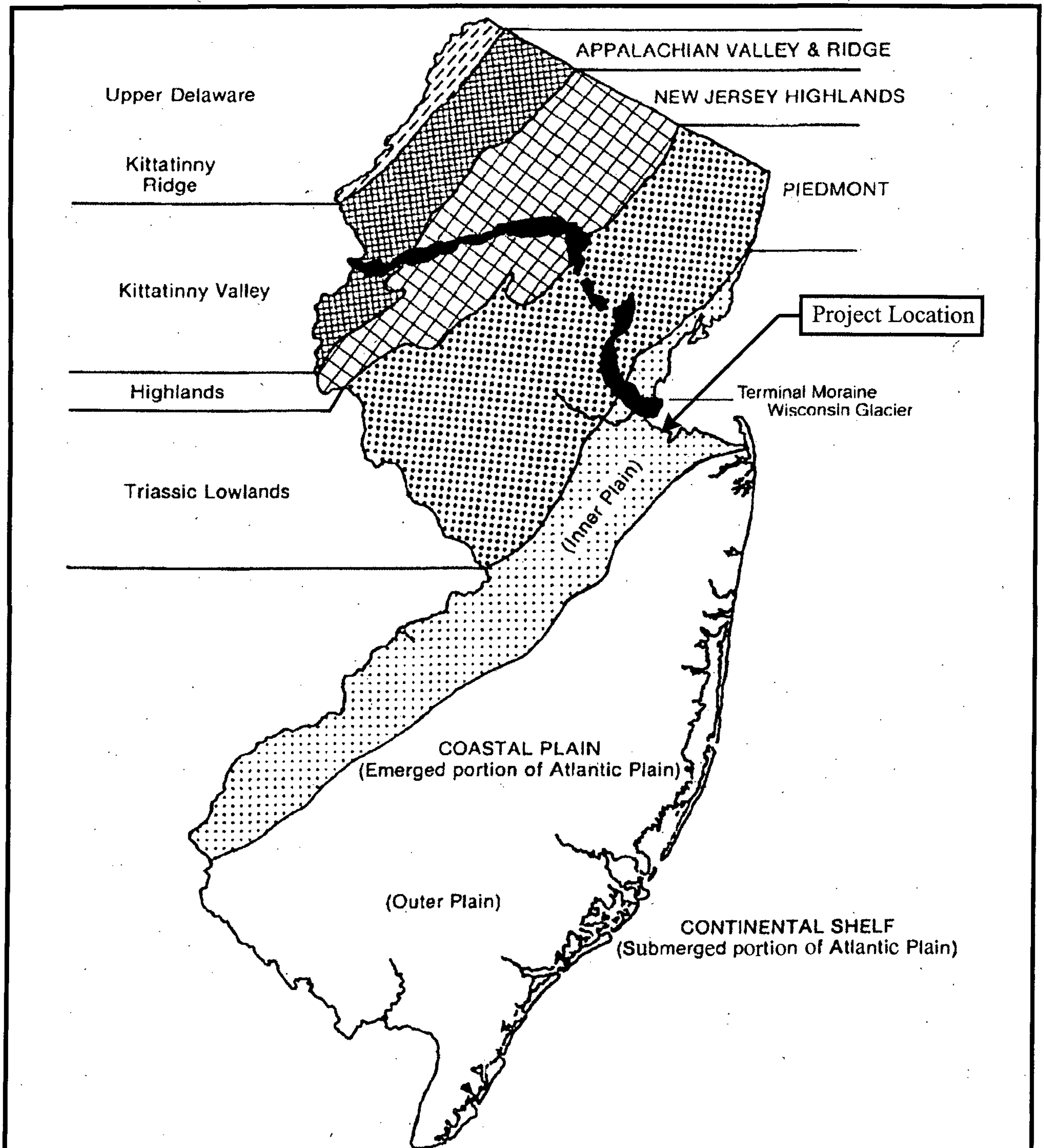

Figure 3:

Physiographic Provinces of New Jersey (from Natural Resources 1999, adapted from Wolfe 1977).

A review of the Middlesex County Soil Survey indicates that the major soil association in the APE is the Keyport-Elkton Association (Powley 1987: 9). Soils within this association consist of moderately well-drained and poorly drained loams. The portion of the APE near Route 35 is mapped as Udorthents with clayey substratum (UC) soils (Figure 4). Udorthents soils consist of moderately deep to deep, well-drained to somewhat poorly-drained soils that formed in stratified or graded, sandy or loamy fill material (Powley 1987: 112). The middle portion of the APE is mapped as Sulfaquents and Sulfihemists (SU) soils (see Figure 4). Sulfaquents and Sulfihemists soils consist of deep, poorly-drained or very poorly-drained, nearly level mineral and organic soils that are subjected to tidal flooding (Powley 1987: 111). Sulfaquents and Sulfihemists soils are found in tidal marshes. Near the Raritan Bay shoreline, the APE is mapped as nearly level Psamments (PN) soils (see Figure 8). Psamments soils consist of moderately deep to deep, excessively-drained to somewhat poorly-drained soils that formed in stratified or graded sandy fill material (Powley 1987: 108).

Marquis Creek, a tidal creek draining into the Raritan Bay, is located 650 feet northeast of the APE (see Figure 2). The southeastem portion of the APE near Route 35 is located on an elevated well-drained landform surrounded by wetlands. The central portion of the APE following a dirt road is surrounded by wetlands. The portion of the APE near the shoreline of the Raritan Bay is located on well-drained land.

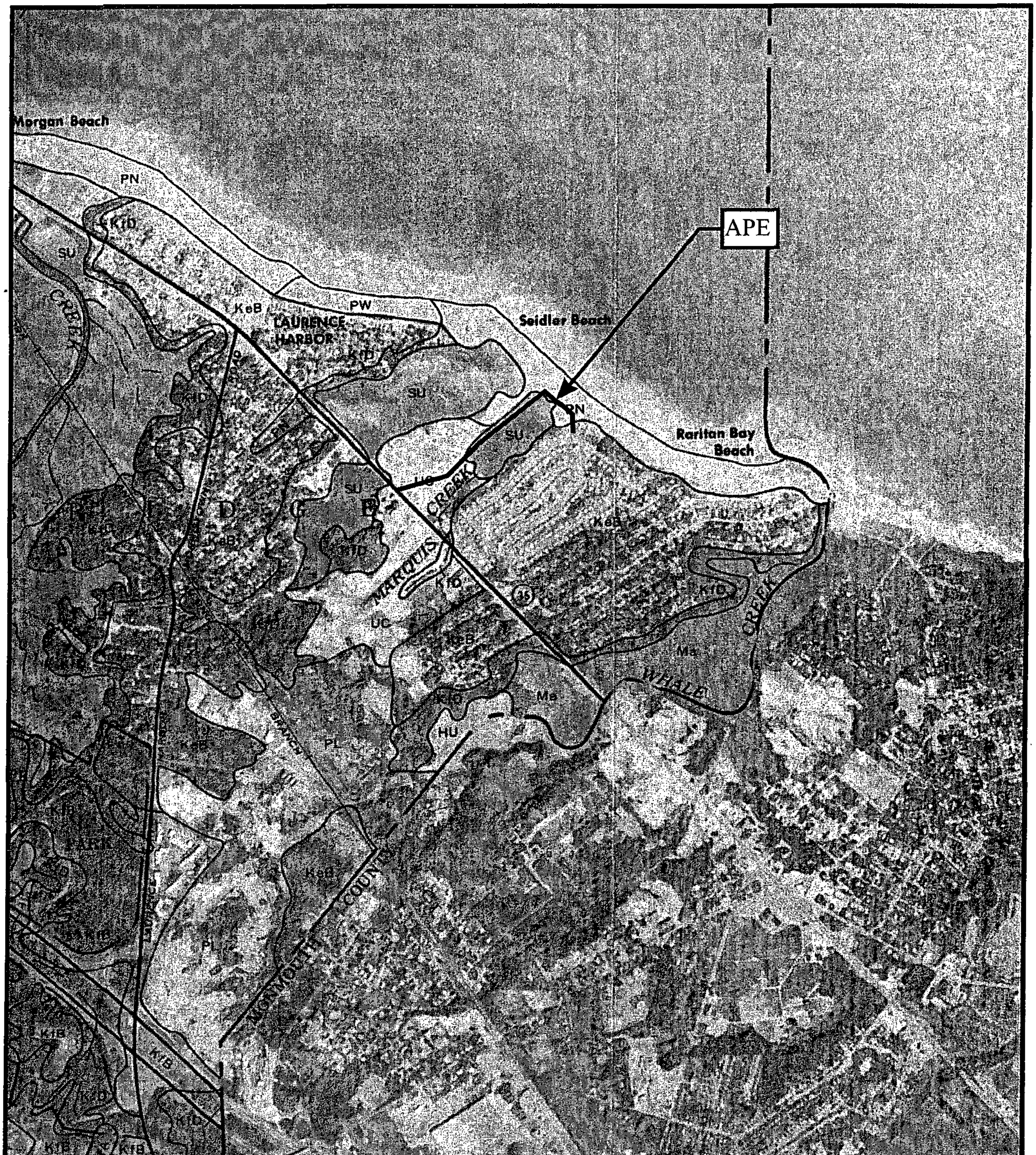

Figure 4:

1987 Van R. Powley, *Soil Survey of Middlesex County, New Jersey*, Sheet Number 16.

SECTION 6.0 RESEARCH GOALS AND DESIGN

The goals of the Phase IA cultural resources survey are first, to identify the presence of any documented historic and/or prehistoric cultural resources within the APE, and second, to assess the probability for undocumented significant cultural resources within the APE.

The research design includes preliminary background research and visual inspection of existing conditions within the APE. Background research is conducted prior to the field investigation to determine whether any cultural resources have been documented within the APE and to assess the area's potential to contain undocumented significant prehistoric or historic cultural resources. In the event that there is a high probability for significant archaeological deposits, a field testing strategy is devised to locate such deposits and further work (Phase IB) is recommended.

Determinations of significance or potential significance are based on the National Register of Historic Places criteria of historic and/or archaeological significance.

6.1 National Register of Historic Places Criteria

Potentially significant historic properties include districts, structures, objects, or sites which are at least 50 years old and which meet at least one National Register criterion. Criteria used in the evaluation process are specified in the Code of Federal Regulations, Title 36, Part 60, National Register of Historic Places (36 CFR 60.4). To be eligible for inclusion in the National Register of Historic Places, a historic property(s) must possess:

> the quality of significance in American History, architecture, archaeology, engineering, and culture [that] is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:
>
> (a) that are associated with events that have made a significant contribution to the broad patterns of our history, or
>
> (b) that are associated with the lives of persons significant in our past, or
>
> (c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components lack individual distinction, or

(d) that have yielded, or may be likely to yield, information important in prehistory or history (36 CFR 60.4).

There are several criteria considerations. Ordinarily, cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register of Historic Places. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

(a) a religious property deriving primary significance from architectural or artistic distinction or historical importance, or

(b) a building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event, or

(c) a birthplace or grave of a historical figure of outstanding importance if there is no other appropriate site or building directly associated with his/her productive life, or

(d) a cemetery which derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events, or

(e) a reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived, or

(f) a property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own historic significance, or

(g) a property achieving significance within the past 50 years if it is of exceptional importance. (36 CFR 60.4)

The physical characteristics and historic significance of the overall property are examined when conducting National Register evaluations. While a property in its entirety may be considered eligible based on Criteria A, B, C, and/or D, specific data is also required for individual components therein based on date, function, history, and physical characteristics, and other information. Resources that do not relate in a significant way to the overall property may contribute if they independently meet the National Register criteria.

A contributing building, site, structure, or object adds to the historic architectural qualities, historic associations, or archeological values for which a property is significant because a) it was present during the period of significance, and possesses historic integrity reflecting its character at that time or is capable of yielding important information about the period, or b) it independently meets the National Register criteria. A non-contributing building, site, structure, or object does not add to the historic architectural qualities, historic associations, or archeological values for which a property is significant because a) it was not present during the period of significance, b) due to alterations, disturbances, additions, or other changes, it no longer possesses historic integrity reflecting its character at that time or is incapable of yielding important information about the period, or c) it does not independently meet the National Register criteria.

SECTION 7.0 BACKGROUND RESEARCH

The Phase IA cultural resources survey included a literature and map search to provide a context for the evaluation of potentially significant prehistoric and historic archaeological resources in the APE and vicinity. Background research was conducted at the HPO in Trenton, the New Jersey State Library and Museum (NJSM) in Trenton, and the Old Bridge Public Library in Old Bridge. Original research was conducted by Richard Grubb & Associates staff to obtain data presented in this section.

A search of the archaeological site files at the NJSM indicated there is one registered archaeological site (28-Mi-20) that may encompass a portion of the APE. Site 28-Mi-20 was mapped in the proximity of where a dirt road extends to the Raritan Bay shoreline in the general vicinity of the APE. Skinner and Schrabisch (1913: 45) describe Site 28-Mi-20 as comprising of "two small camp sites close together near the bay" containing "oyster shells and flint chips." Site 28-Mi-19 was located near Route 35 immediately south of the APE. The boundaries of Site 28-Mi-19 as mapped at the NJSM were less then 300 feet from the APE. Skinner and Schrabisch (1913: 45) describe Site 28-Mi-19 as "a camp site on the high point east of [Marquis] creek." No firther information is available about Site 28-Mi-19 and 28-Mi-20.

There are 12 registered archaeological sites within one mile of the APE. Table 1 provides the type and location of recorded sites. One umegistered shell midden was investigated by Charles A. Philhower (1927) in "Lawrence Harbor on the southem slope, near the point along the marsh to the right of the shore road to Keyport [Route 35] (1927: 396)." It is unclear how close this site is to the APE. The site was a shell heap containing Native American pottery, lithics, projectile points, bone tools, duck bones, turtle bones, deer bones, bear bones, a human burial, hand-wrought nails, historic pottery, and glass (Philhower 1927: 396). Prehistoric resources near the APE reflect a focus on estuarine resources. Several of the sites are situated on well-drained landforms adjacent to salt-marshes and consists of shell middens. Few details besides Philhower's descriptions are available for the sites in the vicinity of the APE.

Table 1: Registered Archaeological Sites in the Vicinity of the APE.

Site #	Site Type	Location	Period	Reference
28-Mi-17	Shell Midden	Raritan Bay Shoreline	Unknown Prehistoric	NJSM
28-Mi-18	Shell Midden	Marquis Creek	Unknown Prehistoric	NJSM
28-Mi-19	Shell Midden	2000 feet from Raritan Bay	Unknown Prehistoric	NJSM
28-Mi-20	Shell Midden	Raritan Bay Shoreline	Unknown Prehistoric	NJSM
28-Mi-76	Shell Midden	Stump Creek	Probably Late Woodland	NJSM
28-Mi-77	Shell Midden	Stump Creek	Probably Late Woodland	NJSM
28-Mi-78	Shell Midden	Stump Creek	Probably Late Woodland	NJSM
28-Mi-79	Shell Midden	Stump Creek	Probably Late Woodland	NJSM
28-Mi-228	Shell Midden	Bluff, 800 feet from Raritan Bay	Woodland	NJSM
28-Mo-7	Shell Midden	Long Neck Creek	Unknown	NJSM
28-Mo-155	Shell Midden	Long Neck Creek	Woodland	NJSM
28-Mo-299	Ephemeral Camp	Whale Creek	Unknown Prehistoric	NJSM

NJSM--New Jersey State Museum

A review of early archaeological surveys was undertaken in order to collect additional information about prehistoric sites in eastem Middlesex County (Cross 1941; Skinner and Schrabisch 1913). Cross (1941:224) reports one site in Laurence Harbor on the east site of Cheesequake Creek that contained oyster shells, prdjectile points, ceramic, and bones. Skinner and Schrabisch (1913) recorded two sites near the APE and numerous other ones along the Raritan Bay and associated inundated tributaries. However, a number of sites, ranging in age from Archaic to Woodland Period, were found on the South River and on the bluffs at the confluence of Cheesequake Creek and Raritan Bay to the west of the APE. These site types ranged from short term camps to villages, many of which contained shell deposits (Skinner and Schrabisch 1913: 45-47).

Several cultural resources surveys have been conducted within one mile of the APE (Brighton 1995, 2000; Brown and Tull 1994; Cultural Resources Consulting Group 1992, 1999; Cultural Resource Management Services 1978; La Porta & Associates, Inc. 1998; Martin et al. 2003; Richard Gmbb & Associates, Inc. 2001, 2003; Rutgers Archaeological Survey Office 1978; Wilson 1986). Three cultural resources surveys have been conducted adjacent to the APE, but no archaeological testing was conducted in the APE. Most of these cultural resources surveys did not find any archaeological resources (Brighton 1995, 2000; Cultural Resources Consulting Group 1992, 1999; Cultural Resource Management Services 1978; La Porta & Associates, Inc. 1998; Martin et al. 2003; Richard Gmbb & Associates, Inc. 2003; Rutgers Archaeological Survey Office 1978). Archaeological resources identified are summarized below.

Site 28-Mo-299 was identified during a Phase I archaeological survey for a commercial/industrial development located south of the APE (Richard Grubb & Associates, Inc. 2001). Site 28-Mo-299 was interpreted as a short-term occupation hunting station or procurement camp. Since no diagnostics were found and only a limited amount of artifacts were recovered, no additional testing was conducted.

The Long Neck Creek I site (28-Mo-155) was discovered by archaeologist Budd Wilson (1986) near a springhead of Long Neck Creek. Although much of 28-Mo-155 had been destroyed by historic mining activity, some prehistoric cultural material was found *in situ*. Artifacts recovered included chert flakes, clam, and oyster shell. No information was available regarding the quantity of shell recovered or the spatial distribution of artifacts at the site. It is possible that four additional prehistoric archaeological sites are located in the vicinity, as indicated by Budd Wilson (Wilson 1986).

A Phase IA investigation for Route 35 intersection improvements identified sensitivity for archaeological resources (Brown and Tull 1994). Richard Grubb & Associates, Inc. (2003) conducted Phase IA/IB survey in these sensitive areas identified by Brown and Tull (1994) along Route 35 and other areas along Route 35. No archaeological resources were found. A portion of the Phase I survey in the immediate vicinity of the southern portion of the APE did not locate any archaeological resources in the 25-foot interval shovel test pits (STPs) (Richard Grubb & Associates, Inc. 2003).

Two previous cultural resources surveys were conducted immediately adjacent to the APE (Brighton 1995; Rutgers Archaeological Survey Office 1978). Rutgers Archaeological Survey Office (1978) conducted a Phase I archaeological survey for a sewer alignment which parallels the Raritan Bay shoreline less than 100 feet east of the APE. Several three-foot auger borings were excavated near the APE that encountered pebbles and sandy fill. No cultural material, besides modern trash, was found in this survey. Nancy Brighton (1995) conducted a Phase IA survey for a beach replenishment project encompassing the Raritan Bay shoreline near the APE. No resources within the APE were identified in the Phase IA survey and the sensitivity was assessed as low.

Prehistoric resources within the confines of Cheesequake State Park southwest of the APE included a shell midden and a campsite that yielded Early/Middle Archaic bifurcate-based points, and a variety of stemmed, side-notched, and triangular point forms. An avocational archaeologist, E.J. Mason, alleged that burials were present within the shell midden deposits, but excavation was not conducted to verify this assertion. The potential for Paleo-Indian occupation at the park has also been suggested. The park was also on the route of a branch of the Great Minisink Trail, used during protohistoric times (Fittipaldi 1983).

No National Register or State Register historic properties are located in the APE. The Garden State Parkway (SHPO Opinion: 10/12/2001) is the closest historic property to the APE, located approximately one mile southwest of the APE.

In summary, background research included a review of archaeological site files and cultural resources surveys. Several cultural resources surveys were conducted within the proximity of the APE, but few resources have been identified. Two registered archaeological sites (28-Mi-19 and 28-Mi-20) were located possibly within or immediately adjacent to the APE. Based on known prehistoric sites in southeastem Middlesex County, it appears that prehistoric human occupation in the area extended from possible Archaic times through the Late Woodland Period.

7.1 Prehistoric Period

Due largely to the effects of time and changes in the natural environment, prehistoric period archaeological resources are highly ephemeral, and often difficult to locate. In order to organize information from the archaeological record about the pre-European occupants of the New World, archaeologists have devised a three-stage framework. This culture history is constantly changing and undergoing re-organization whenever new evidence is unearthed. The culture history of the pre-Contact Period Native inhabitants in New Jersey is divided into three broad time periods: Paleo-Indian 10,000-6000 B.C., Archaic 6000-1000 B.C., and Woodland 1000 B.C.-A.D. 1600 (Chesler 1982). Much synthesis of these periods has been undertaken and need not be repeated here. Basic information for each time period is provided in Table 2. Further details on New Jersey prehistory can be accessed in the following sources: Chesler (1982), Grossman-Bailey (2001), Kraft (1986, 2001) and Mounier (2003).

Table 2: Southern New Jersey Prehistory

Time Frame	**Period**	**Characteristics**
A.D. 1550/1600 to A.D. 1750	Contact	-European contact and initial colonization -continuity of aspects of Algonkian ideology
A.D. 900 to A.D. 1600	Late Woodland	-triangular projectile points - bow and arrow -unfortified hamlets, camps, smaller territories -territories of the proto-Lenape/Unami, Algonkian ideology -foraging, limited agriculture in portions of southern NJ -cord-decorated and incised ceramics -use of cobble cherts and jasper -climate: modem - sea level rise remains a factor
A.D. 0 to A.D. 900	Middle Woodland	-hunter-gatherers, seasonal fission/fusion of social groups -large and small camps -more kinds of ceramics -mortuary ceremonialism -large scale exploitation of seasonal resources
1000 B.C. to A.D. 0	Early Woodland	-band level society with first evidence of community identity -mortuary ceremonialism -extensive trade networks for exotic raw materials -shellfish exploitation -experimentation and early use of ceramics -climate: cool and wet
1000 B.C. to 3000 B.C.	Late Archaic	-broadspear, narrow-stemmed, fishtail points -mortuary ceremonialism -extensive trade networks for exotic raw materials -intensive use of local materials -social differentiation -increased sedentary groups -change in vessel technology - soapstone bowls -climate: warmer & dryer than present, sea level rise slows
3000 B.C. to 6500 B.C.	Middle Archaic	-bifurcate points, stemmed points -hunter-gatherers with increasing intensification of resource use -use of shell fish documented in the region -use of more varied lithic materials and tool categories -large and small camps, stratified riverine settlement system -band level society -climate: warm and wet
6500 B.C. to 8000 B.C.	Early Archaic	-comer-notched and stemmed point types -spear - thrower technology -use of more types of stone for tools -exploitation of more kinds of food resources(?) -very similar to Paleo-Indian Period -climate: cold and drier than present, rapid sea level rise
8000 B.C. to 9500 B.C.	Paleo-Indian	-highly mobile -large game hunting followed by generalized foraging pattems -fluted projectile points usually made of jasper or chert -band level society -climate: cold and wet, mosaic of mixed grasslands, extremely rapid sea level rise

7.2 Historic Period

Before the formal founding of townships in the area, the APE was part of the Navesink Patent (1665). This was a large area south and west of the Raritan Bay and River that encompassed much of Monmouth and Middlesex Counties. Two early settlements, east of the APE, were Middletown and Shrewsbury, settled by the Long Island farmers who were the initial grantees (Snyder 1969: 5, 7).

The APE fell within the jurisdiction of Perth Amboy Township in Middlesex County, formed in 1693. The portion of the township south of the Raritan River was incorporated as South Bmnswick in 1798, and ran from Manalapan Brook east of Jamesburg, north to the Raritan Bay, and west along the Raritan River as far as the present East Brunswick Township. The APE became part of Madison Township, which was formed in 1869, and subsequently renamed Old Bridge Township in 1975 (Snyder 1969: 170, 172-173, 175; League of Women Voters 1976: 6). Settlement in Madison Township started in the early eighteenth century at Cheesequake, near the head of navigation of the Cheesequake Creek (Clayton 1882: 814). Early pioneers were also concentrated in the Browntown neighborhood (Wall and Pickersgill 1921: 441). Early family names in the township include Owens, Wood, Furman, Burlew, Gordon, Hillier, Wright, Clark, Seaman, Provost, Bennett, and Bloodgood (Wall and Pickersgill 1921: 441-442).

Early economic ventures in what was to become Old Bridge Township included gristmills, sawmills, and potteries (League of Women Voters 1976: 6). Although the area's initial economic base was mainly agricultural, the presence of a densely settled village in what is now South Amboy ensured at least some commercial activity. Wood and timber trade was another important early industry in Old Bridge (Clayton 1882: 819). According to Wall and Pickersgill (1921: 442), before the advent of railroads, the boat traffic along South River and Cheesequake Creek was large; great quantities of produce and commerce, designed for shipment to New York was being brought to the various landings from far inland by horse teams for transfer to vessels. Products shipped from the area included lumber and rough logs, produce, hay, and grain.

One of the most important early industries in Madison Township pertained to its rich clay beds. In the eighteenth century, several early stoneware potteries were built near the headwaters of the Cheesequake Creek, and clay from the area was used for their potteries (Martin and Smith 1979: 117). In addition to supplying area potteries, clay from the area was also shipped out of the area on sloops. Owners of clay banks included Sheriff O. Clark, Noah Furman, E.R. Rose, James

Morgan, Otto Ernst, Harry C. Perrine, Wame & Letts, Everett & Perrine, Charles Reynold, and Theodore Smith (Martin and Smith 1979: 121-124).

Economic endeavors increased markedly after the completion of the Camden and Amboy Railroad in 1834. The route ran up the east bank of the Delaware to Bordentown, and thence overland to South Amboy, from which point goods and passengers were transshipped to coastal vessels for the remainder of the joumey to New York and points north. The proprietors of the Camden and Amboy Railroad vigorously opposed any attempt at a second rail line across the state. They subsequently bought out the Philadelphia and Trenton Railroad and built a line between Trenton and New Bmnswick in 1838. Their Amboy Line continued to be important and was upgraded in the 1860s. Although traffic increasingly passed to the New Bmnswick line, industrial development increased along the railroad's route, affecting the Middlesex County settlements of Jamesburg, Helmetta, Spotswood, Old Bridge, South Amboy, and others (Lane 1939: 289-293).

Early settlement within the area occurred in Morgan, Old Bridge/Sayreville, and South Amboy, all situated with access to tidal and deep water navigation on Raritan Bay or large river channels (Beauregard and Hinds 1998). Smaller scale settlement took place in mral areas, primarily at crossroads and scattered locations on important travel routes in close proximity to productive clay beds. In the mid- to late-nineteenth century, the area surrounding the APE was sparsely settled (Figures 5-8). In the nineteenth century, the APE was located between the settlements of Keyport and South Amboy. The road to Keyport, part of present day Route 35, was laid out between 1850 and 1861 (see Figures 5 and 6). In 1850, the A. J. Brown stmcture shown on an early map was located east of the APE, likely on an upland terrace (see Figure 5). The 1876 Everts and Stewart's Map of South Amboy shows an earlier possible proposed alignment of the New York and Long Branch Railroad between Route 35 and the Raritan Bay (see Figure 7). The 15' U.S.G.S. Sandy Hook Quadrangle and later maps depicts the alignment of the New York and Long Branch Railroad south of Route 35 and not near the APE (see Figure 8; Figure 9). The New York and Long Branch Railroad Historic District is considered an historic resource eligible for listing on the National Register of Historic Places (SHPO Opinion: 8/20/2004; Richard Gmbb & Associates, Inc. 2004). The existing eligible alignment of the New York and Long Branch Railroad was located south of Route 35 and not in the vicinity of the APE (see Figure 8).

By the late-nineteenth century, the area began to develop, primarily due to the clay industry and its growing dependency on the railroad. During this period, the area became heavily industrialized with companies that manufactured brick, terra cotta, and pottery. By 1880, the population of Old Bridge reached 1,662 (League of Women Voters 1976: 6), and the area remained sparsely settled until the 1950s (League of Women Voters 1976: 6). The community of Laurence Harbor developed around the intersection of Route 35 and Laurence Parkway in the late nineteenth and early twentieth century. The APE and vicinity has seen extensive demographic change by the midtwentieth century (see Figure 9), as well-drained lands were used for residential development. The area in the vicinity of the APE was built up between 1954 and 1970 (see Figure 9). No structures were built in the APE in the twentieth century. By 1970, there were 48,715 people recorded as living in the township. Today, the township lands remain primarily devoted to residential housing and commercial ventures. Recent U.S. census records indicate that 83,289 individuals resided in Old Bridge in 2000 (http://factfmder.census.gov). Various residential developments (see Rizzo 1998), now surround the APE.

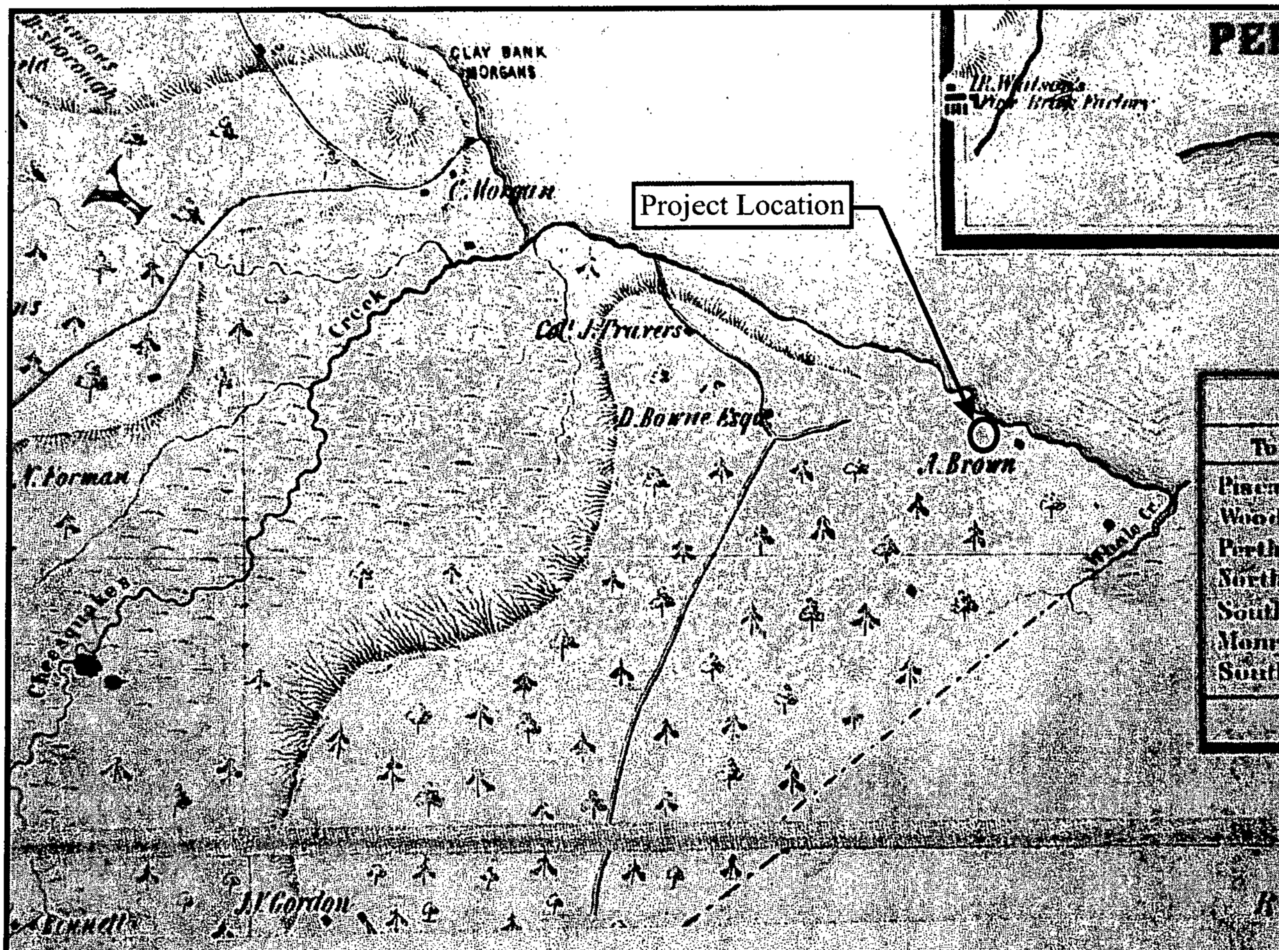

Figure 5:

1850 J. W. Otley and J. Keily, Map of Middlesex County, New Jersey.

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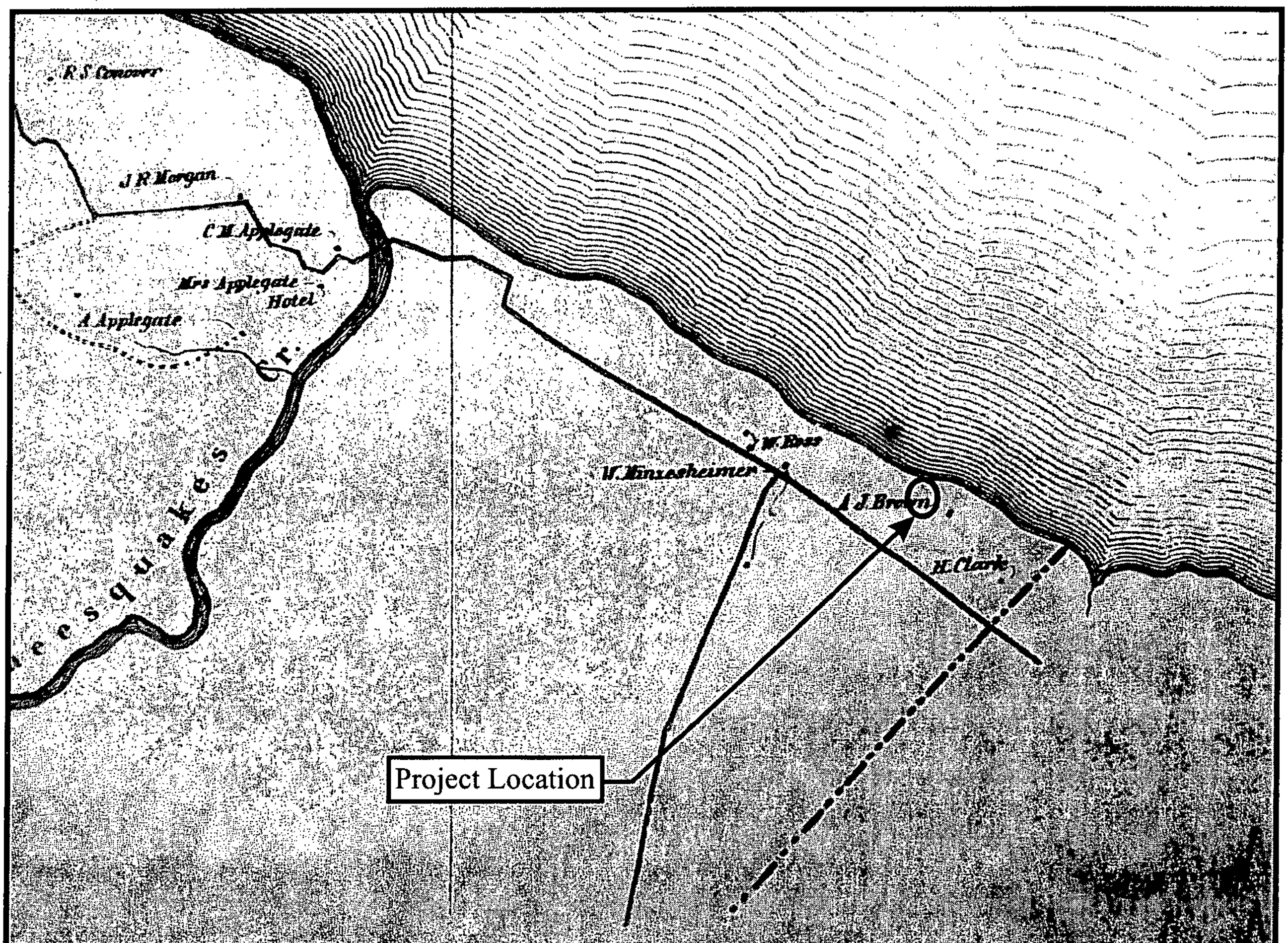

Figure 6:

1861 H. F. Walling, Map of the County of Middlesex, New Jersey.

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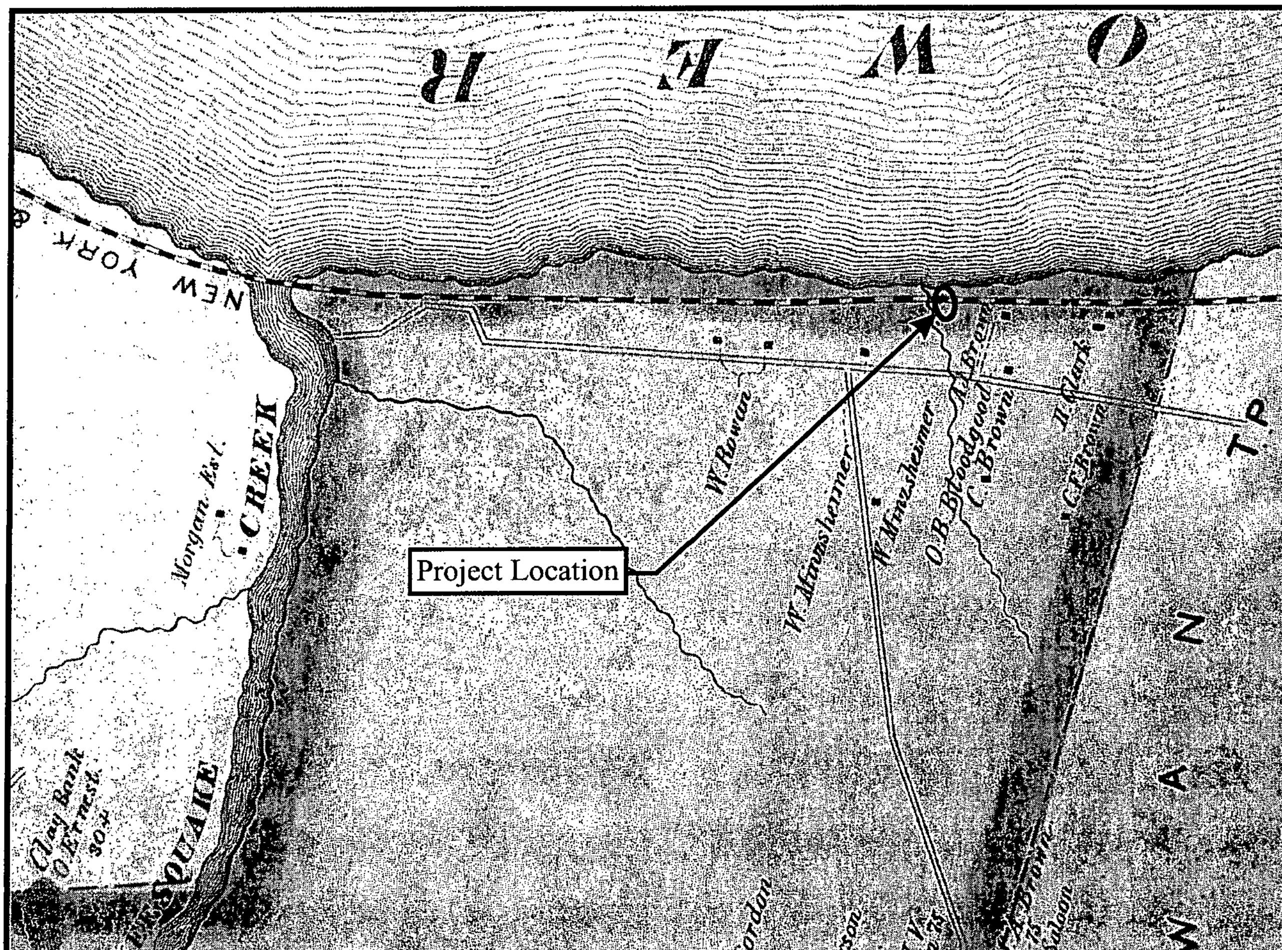

Figure 7:

1876 Everts and Stewart, Map of South Amboy, *Combination Atlas Map of Middlesex County, New Jersey.*

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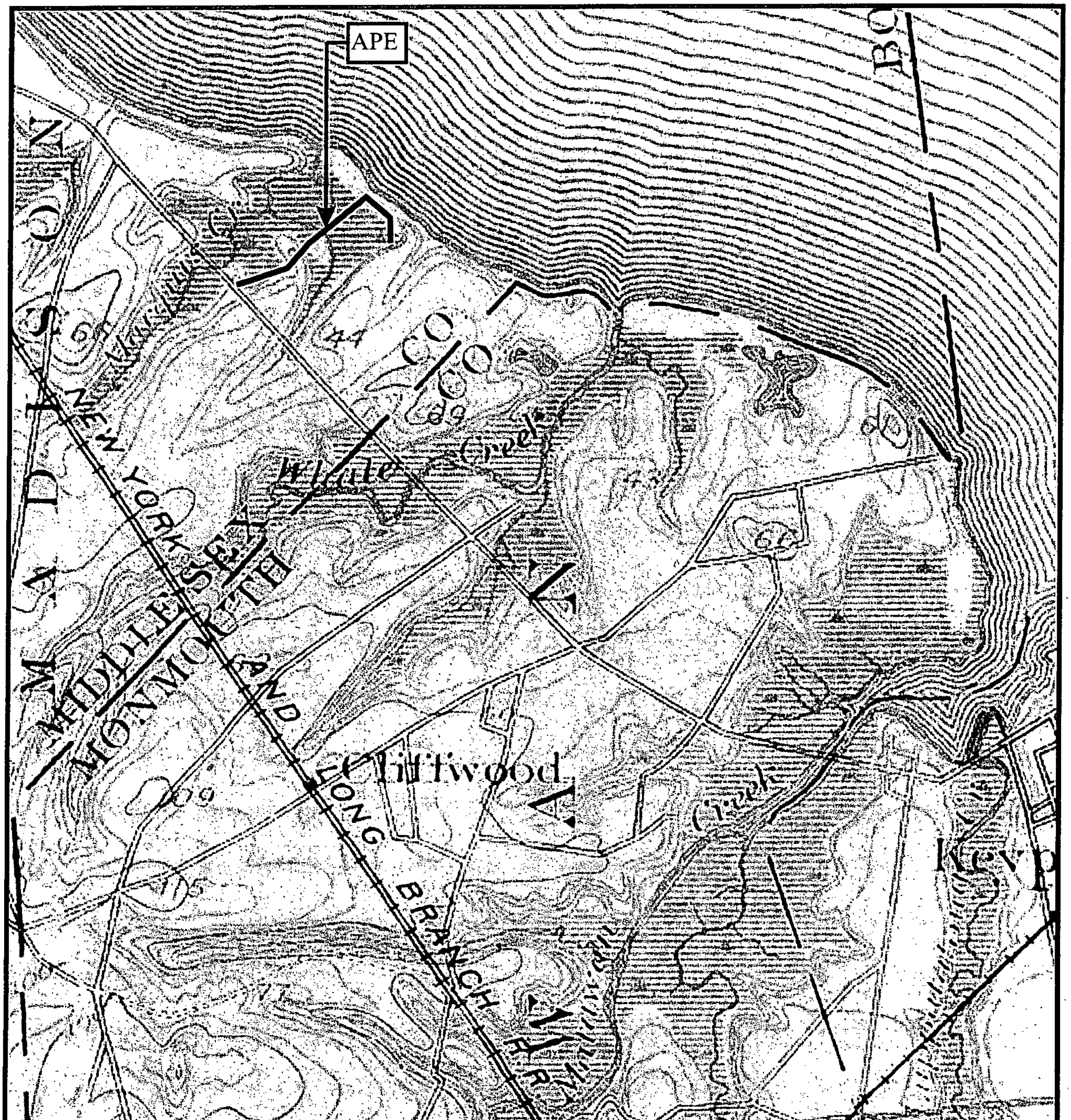

Figure 8:

U.S.G.S. 15' Quadrangle: Keyport, NJ-NY 1901.

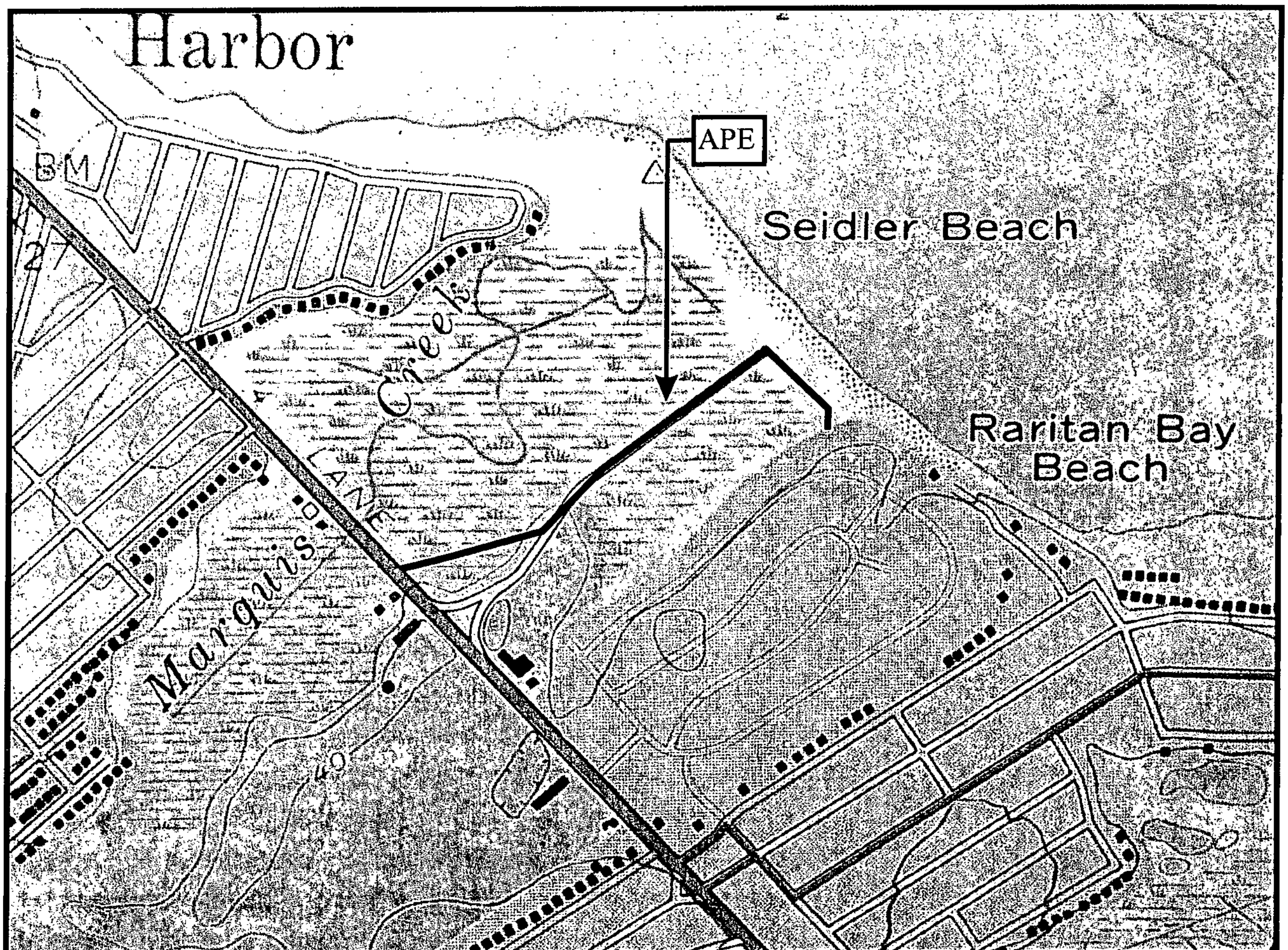

Figure 9:

U.S.G.S. 7.5' Quadrangle: Keyport, NJ-NY 1954 (photorevised 1970).

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SECTION 8.0 RESULTS

The Phase 1A cultural resources survey was intended to assess the probability for significant documented and undocumented historic and prehistoric archaeological resources within the APE. Background research and a site visit were used to assess the potential for the presence or absence of significant archaeological sites, and recommendations made for further investigation, if warranted.

In order to assess the overall sensitivity of the APE for the presence of prehistoric period cultural resources, it was necessary to review the results of several studies that have been conducted to formulate predictive models of archaeological site location. While none of these studies has been performed within the immediate vicinity of the APE, they have resulted in the formulation of empirical generalizations that have proven usefiil outside of the study area.

A sensitivity assessment for historic archaeological resources is dependent on the examination of historic maps and local inventories of historic resources to identify whether a site may have been present in the vicinity of the APE.

8.1 Assessment of Cultural Resources Sensitivity

Prehistoric Archaeological Resources

Research conducted in the Inner Coastal Plain indicates that the vast majority of prehistoric sites are located within 300 feet of water (Cavallo and Mounier 1982; Pagoulatos and Walwer 1991; Ranere and Hansell 1985). Sites have also been found in areas outside of 300 feet of water, particularly on drainage divides and upland areas, but these sites are much fewer in comparison with those near watercourses (Cavallo and Mounier 1982). Studies have also demonstrated that prehistoric sites are more apt to be situated in close proximity to soils with good drainage, level topography, historic trails, and areas offering a decent vantage point (Pagoulatos and Walwer 1991). Upland settings bordering wetlands associated with major watercourses are also considered to be high potential areas for prehistoric cultural resources (Hasenstab 1991).

The 1901 15' U.S.G.S. Sandy Hook Quadrangle indicates that a partially filled-in tributary of Marquis Creek crossed the APE (see Figure 8). The natural character of the tributary was likely altered when the dirt road in the APE was constmcted. The dirt road was constmcted by 1954 (see Figure 9). The well-drained land near the southeastem end of the APE and Route 35 has the highest potential for prehistoric archaeological sites. Site 28-Mi-19 is plotted near this portion of the APE. Site 28-Mi-20 is plotted near the Raritan Bay shoreline where the alignment makes a 90° tum. Site 28-Mi-20 is plotted near the APE. Previous Phase IB testing suggests that the portion of the APE near the Raritan Bay shoreline may be partially disturbed (Rutgers Archaeological Survey Office 1978). Construction activities related to shore and hurricane protection in the 1960s and 1970s along the Raritan Bay shoreline may have compromised the natural landscape (Brighton 1995). Background research suggests that most prehistoric sites fall on the well-drained landforms and other settings beside perennial water. Prehistoric sites may also be located below marsh deposits on buried land surfaces that were inundated by Holocene sea level rise.

Background research and the topographic setting of the APE indicate the potential and sensitivity for prehistoric archaeological resources is high.

Historic Archaeological Resources

The review of historic maps indicated that a possible proposed late-nineteenth-century alignment of the New York and Long Branch Railroad might be located in the APE near the Raritan Bay shoreline (see Figures 7); therefore, the APE has a moderate to high sensitivity for historic archaeological resources.

8.2 Archaeological Fieldwork

The Phase IA cultural resources survey included a visual examination of the APE by the Principal Investigator on February 9, 2005. Soil borings conducted by ERC and Craig Test Boring were also evaluated to characterize the soils and sediments in the APE. Primarily only the upper 20 feet of the soil borings were evaluated. Most of the APE is currently undeveloped except for the existing pump station. In the vicinity of the manhole near Route 35 at the start of the alignment, the ground surface has been recently disturbed (Plate 1). An artificial berm was located in this area. Soil Boring (SB) 9 was located in the northeasteru side of the berm on relatively level ground in the APE (see Attachment; Plate 2). The upper 20 feet of the profile in SB 9 consisted ofi one-foot thick yellowish brown fine sand, one-foot thick grey silty sand, five-foot thick grayish brown silty clay, seven-foot thick dark gray and reddish (possibly glade) yellow silty clay, and a greater than six-foot thick strata of dark gray silt. No shell was encountered in the soil boring. In SB 9, the upper two feet might be fill and the lower portion, natural soils and sediments. The portion of the APE between Route 35 and the dirt road consists of well-drained land containing saplings and five-to-ten inch diameter trees (Plates 3 and 4). The forest is not mature and growth may be stunted because of saltwater intrusion. The ground surface appears natural in the portion of the alignment between SB 9 and where the alignment intersects the dirt road.

Plate 1:

Start of Alignment at Manhole. Overview of artificial berm.
Photo view: Northeast
Photographer: Jesse O. Walker
Date: February 9, 2005

Plate 2:

Overview of APE in Vicinity of Soil Boring 9.
Photo view: Northeast
Photographer: Jesse O. Walker
Date: February 9, 2005

Plate 3:

Overview of APE Crossing Well-Drained Landform.
Photo view: East
Photographer: Jesse O. Walker
Date: February 9, 2005

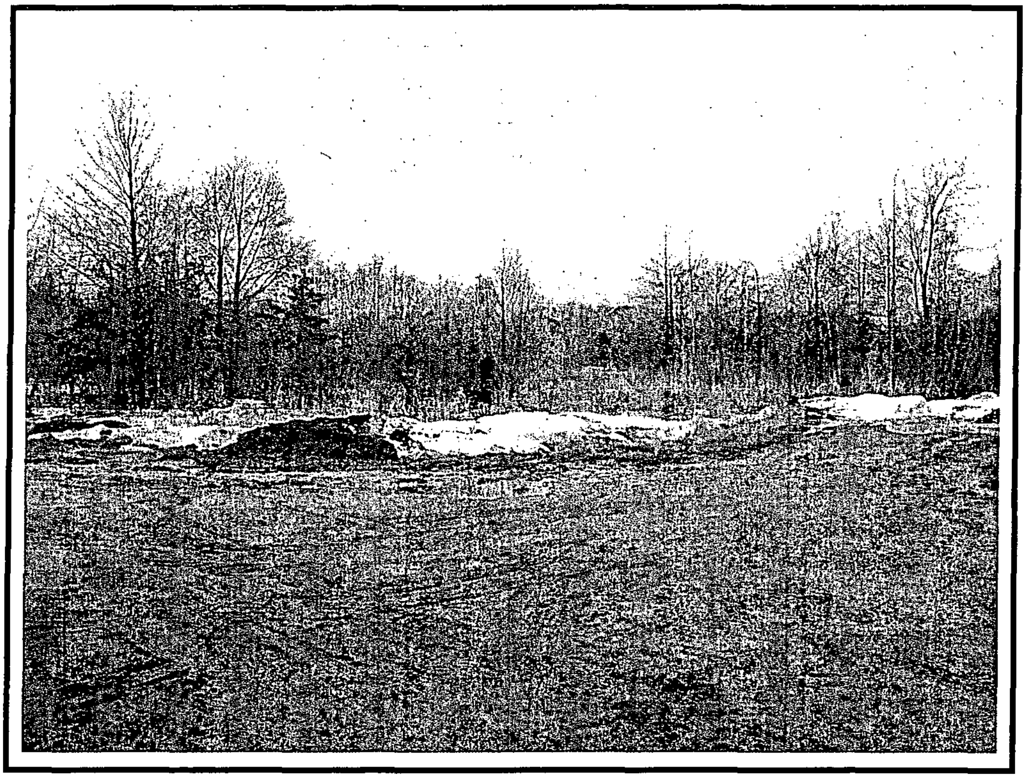

Plate 4:

Overview of APE From Dirt Road.
Photo view: West
Photographer: Jesse O. Walker
Date: February 9, 2005

Three soil borings (SBs 10, 11, and 12) were located in this wooded portion of the APE (see Attachment). The profile in SB 10 consisted of a two-foot thick brownish yellow silty sand, ten-foot thick dark gray clay silt with organic matter, and 20-foot thick dark gray clay silt with organics. Trace amounts of shell were encountered at 25 feet below the surface. The profile in SB 11 consisted of a two-foot thick brownish yellow sand, seven-foot thick brown sandy silt clay, and an over 20-foot thick dark gray silty clay with organic matter. The profile in SB 12 consisted of a two-foot thick strong brown sandy with gravel, 15-foot thick gray and yellowish brown clay silt, and five-foot thick dark gray silty clay with organic matter. In SBs 10, 11, and 12, the presence of organics in the dark gray silt clay at approximately ten feet below the ground surface suggests that this dark gray silt clay might be tidal flat sediments. The profiles suggests that the sediments were primarily natural with possibly some fill in the upper one to two feet of the profile. Soil Boring 3 located 240 feet north of the APE contained shell fragments between 23 and 30 feet below the ground surface (see Attachment). It is unknown if the shell was derived from cultural or natural processes.

A topographic highpoint is located where the APE crosses the high-density above ground polyethylene pipe and intersected the dirt road (Plate 5; see Attachment). Larger trees are located on this higher well-drained ground (see Plate 5). The 1901 15' U.S.G.S. Sandy Hook Quadrangle indicates that this portion of the APE was a natural topographic high point overlooking the tributary of Marquis Creek (see Figure 8).

The APE follows along the southeastern side of a dirt road for approximately 400 feet. Along the side of the road are small trees and some push piles. Soil Boring 1 was located in this portion of the APE. The profile in SB 1 consisted of a two-foot thick brownish yellow sandy fill that was overlying a 14-foot thick gray clay silt to sandy silt strata, which may also be fill deposits. A gray silty sand was encountered at around 16 feet below the ground surface extending over 20 feet below the ground surface. The 1901 15' U.S.G.S. Sandy Hook Quadrangle indicates that this portion of the APE was a natural lowland near the partially filled-in tributary of Marquis Creek (see Figure 8). Based on the landscape as shown in the 15' U.S.G.S. Sandy Hook Quadrangle, this portion of the dirt road was built on fill. The profile from SB 1 also suggests that the dirt road was partially built on fill.

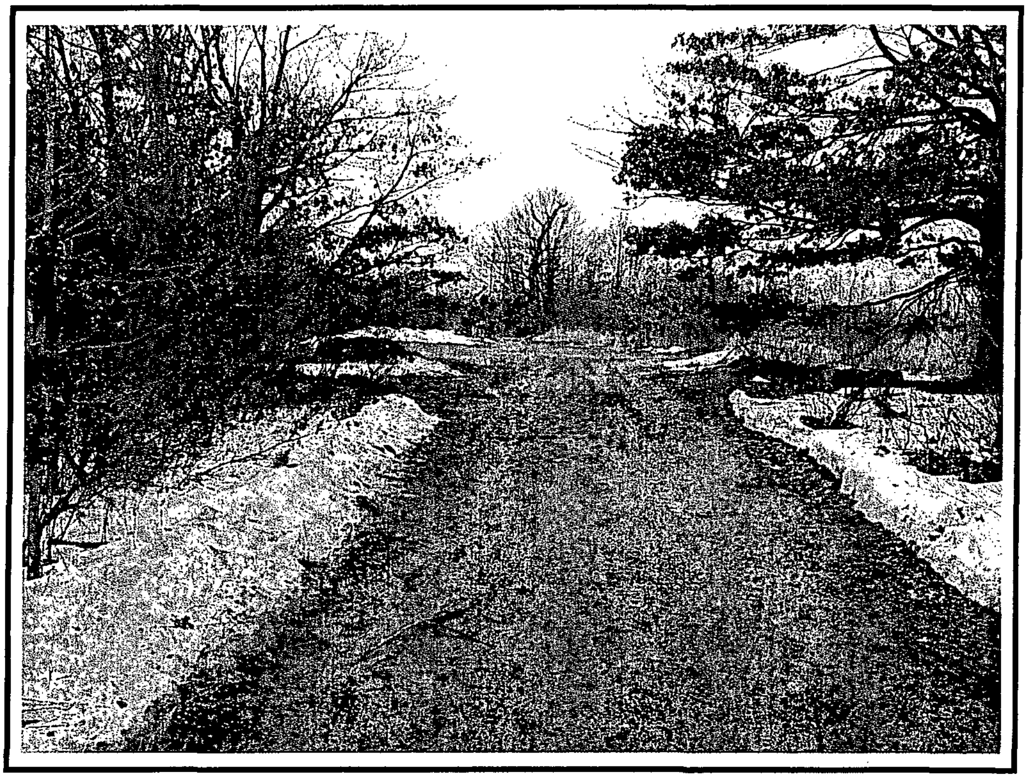

Plate 5:

Topographic High Setting Where APE Intersects the Dirt Road.
Photo view: Southwest
Photographer: Jesse O. Walker
Date: February 9, 2005

The APE shifts to within the bed of the dirt road immediately east of a culvert (see Attachment; Plate 6). The culvert likely represents the location of the partially filled-in tributary of Marquis Creek. The APE remains within the dirt road prior to making a 90°-tum towards the southeast (see Attachment; Plates 7 and 8). Soil Borings 4 and 14 were located in this portion of the APE. The profile in SB 14 consisted of a two-foot thick brownish yellow sand with gravel (road bed fill), seven-foot thick gray clayey silt with organic matter, 15-foot thick dark gray silty clay with organic matter. At approximately 24 feet below the ground surface, shell fragments were encountered. It is unknown if the shell was derived from cultural or natural processes. The profile in SB 4 consisted of a seven-foot thick brownish yellow sand overlaying a dark gray clayey silt greater than 20-feet thick. Shell fragments were encountered at 15 feet below the ground surface. The profiles in SBs 4 and 14 appear to reflect intact natural sediments.

The ground surface was inspected (see Plate 8) in the portion of the APE near the 90° tum in the alignment in the vicinity of where Site 28-Mi-20 is plotted. No prehistoric artifacts or shell was present on the ground surface in this area.

The portion of the APE paralleling the Raritan Bay shoreline is located at the boundary between the grasses and trees (see Attachment; Plate 9). Soil Borings 5, 15, and 16 were located in or near this portion of the APE (see Attachment). The profiles in SBs 5, 15, and 16 were relatively similar and consisted of yellowish brown to reddish yellow and grayish brown sand (five to 12 feet thick) overlying dark gray silt clay with organics (two to 20 feet thick). Shell fragments were encountered in SB 16 at 15 feet below the ground surface and SB 15 at 24 feet below the ground surface. Based on the profiles in SBs 5, 15, and 16, the sediments in this portion of the APE appear to reflect intact natural sediments. Near Station 24+00 along the alignment approximately 40 feet southwest of the APE, an embankment of unknown origin was located on the ground surface (Plate 10). The embankment was covered in snow making identification difficult. The embankment parallels the shoreline and may cross the APE (see Figure 7). The embankment berm is in the general vicinity of the late-nineteenth-century railroad identified as the New York and Long Branch Railroad on the 1876 Everts and Stewart's Map of South Amboy.

Several large push piles were located in the APE in the vicinity of SB 16 (see Attachment; see Plate 9). The ground surface near this portion of the APE appears to have been graded and the topsoil placed in large piles. The ground surface around the existing pump station, where the meter chamber is proposed, has been artificially elevated approximately six feet above the natural topography (see Attachment; Plate 11). The proposed meter station and a portion of the proposed interceptor sewer are located on the edge of this artificial elevated landform associated with the pump station. Soil Boring 6 was located on the approximately 30 east of the chain-link fence on the flat ground next to the pump station. The profile in SB 6 consisted of a 12-foot thick yellowish brown sand overlaying a dark gray to gray clayey silt greater then 10-feet thick. A small amount of shell fragments were present in the gray clayey silt at approximately 15 feet below the ground surface.

Plate 6:

Overview of APE in Dirt Road.
Photo view: Northeast
Photographer: Jesse O. Walker
Date: February 9, 2005

Plate 7:

Overview of APE in Dirt Road.
Photo view: Southwest
Photographer: Jesse O. Walker
Date: February 9, 2005

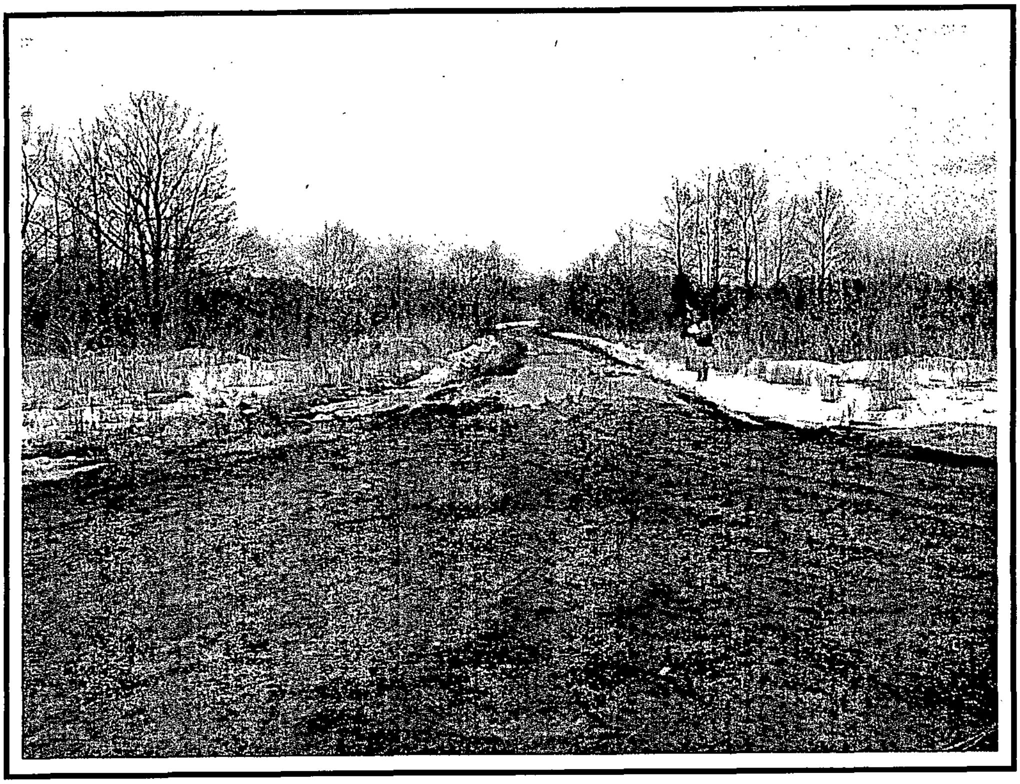

Plate 8:

Overview of APE in Dirt Road.
Photo view: Southwest
Photographer: Jesse O. Walker
Date: February 9, 2005

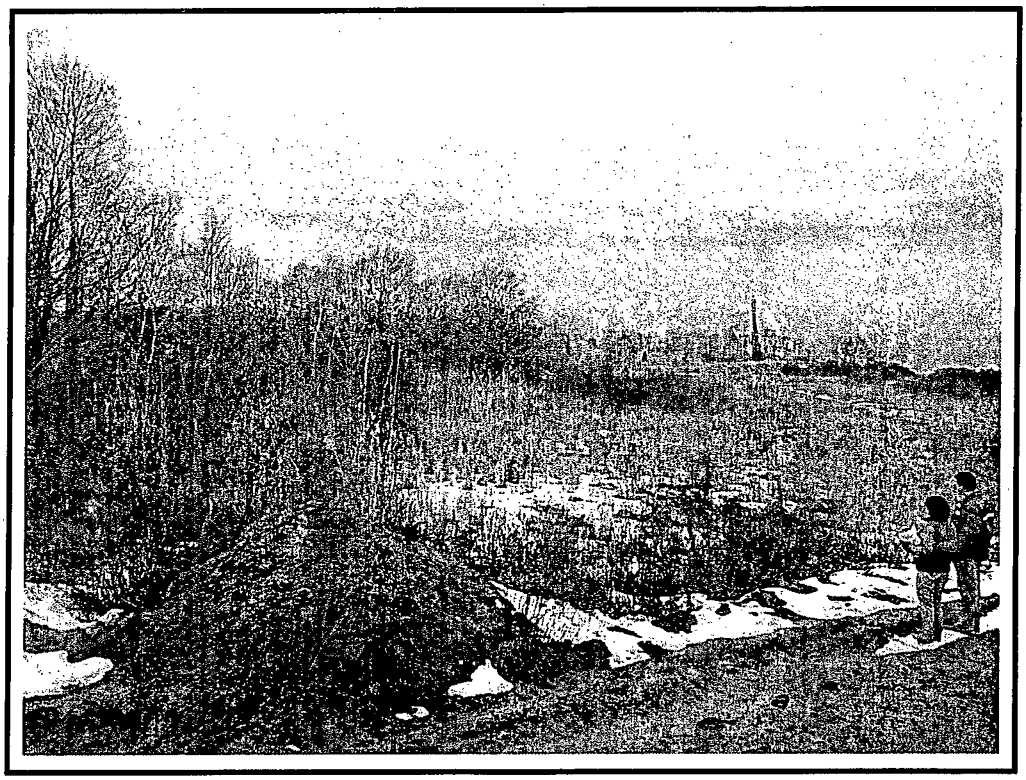

Plate 9:

Overview of APE Near Raritan Bay Shoreline.
Photo view: Northwest
Photographer: Jesse O. Walker
Date: February 9, 2005

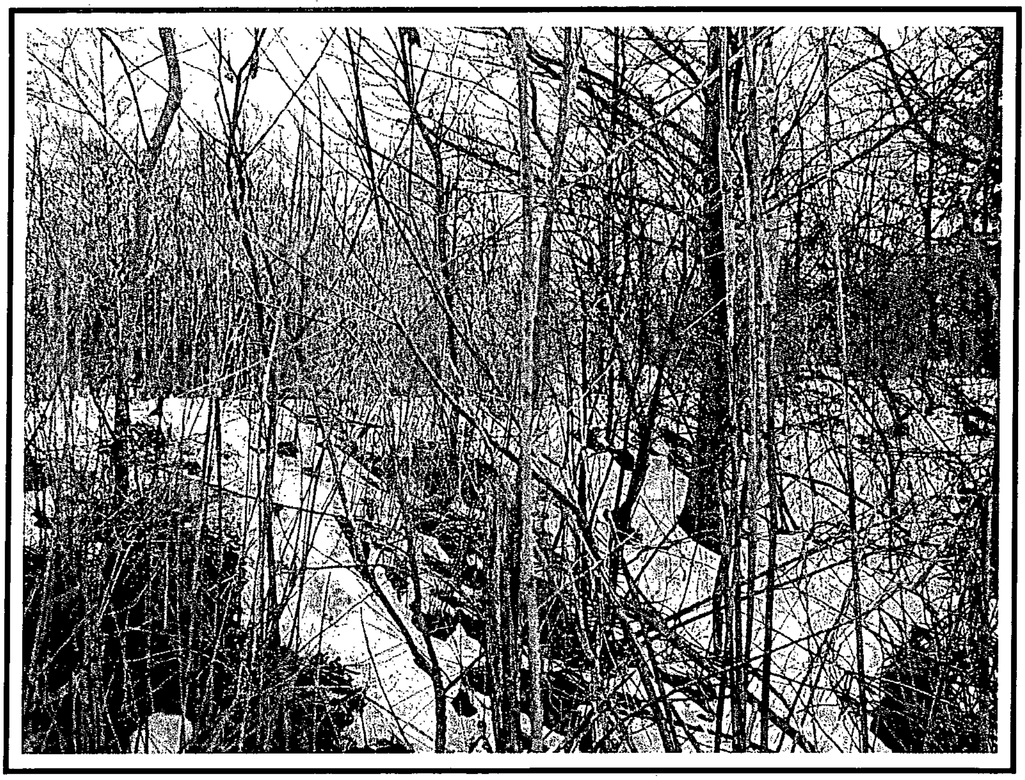

Plate 10:

Overview of Possible Railroad Bed.
Photo view: East
Photographer: Jesse O. Walker
Date: February 9, 2005

In sum, a limited portion of the APE has experienced disturbance near the existing pump station and Route 35 as well as along the dirt road. Historic map research and soil boring data suggest that fill may have been used to construct portions of the dirt road. Below the roadbed fill, there is a potential for natural sediments and soils. No prehistoric artifacts were observed in the field visit. Only modem trash was observed on the ground. Given the proximity of Sites 28-Mi-19 and 28-Mi-20 as well as the proximity of the Raritan Bay and the partially in-filled tributary of Marquis Creek, the APE is considered to have a high potential for prehistoric archaeological resources. Based on the location of the possible railroad bed, the APE is considered to have a moderate potential for historic archaeological resources.

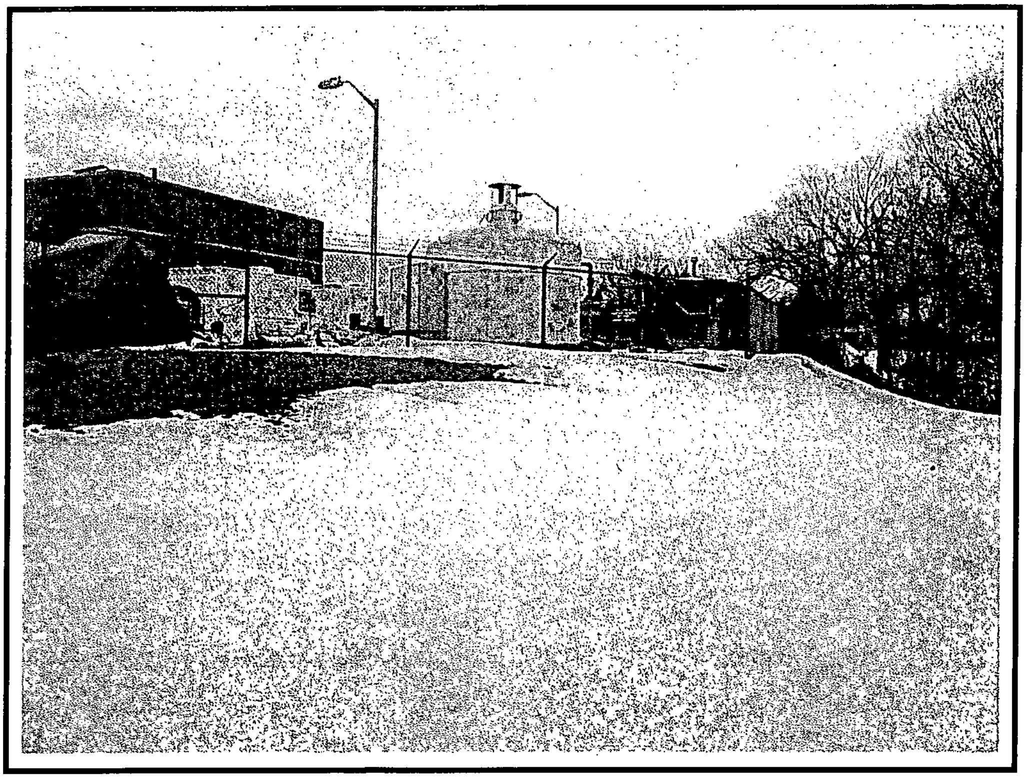

Plate **11:**

Overview of Location of Proposed Meter Chamber Site, APE, and Pump Station.
Photo view: South
Photographer: Jesse O. Walker
Date: February 9, 2005

SECTION 9.0 MANAGEMENT RECOMMENDATIONS

A Phase IA cultural resources survey was performed within the APE for the proposed Laurence Harbor Interceptor in Old Bridge Township, Middlesex County, New Jersey. Based on background research, topographic setting, and a site visit, the APE is considered to have a high probability for containing significant prehistoric cultural resources and a moderate probability for containing significant historic cultural resources. It is the recommendation of Richard Grubb & Associates that a Phase IB cultural resources survey be required. For prehistoric resources, systematic shovel testing is recommended in the upland sections of the APE. The historic archaeological sensitivity is considered moderate to high because of the potential for a rail-line associated with the New York and Long Branch Railroad, or another late-nineteenth-century transportation-related resource, in or near the APE.

It is the recommendation of Richard Grubb & Associates that a Phase IB cultural resources survey be performed. For prehistoric resources, systematic shovel testing is recommended in the upland sections of the APE. Additional historical research of an unidentified embankment (i.e. the possible rail-line or transportation related feature) in or near the APE should also be conducted as part of the Phase IB survey to clarify the history, nature, and function of this potential resource. If the embankment is found to represent a late-nineteenth-century transportation corridor, archaeological testing will be conducted to assess its potential significance.

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SECTION 11.0 APPENDICES

APPENDIX A: ANNOTATED BIBLIOGRAPHY

Author:	Jesse O. Walker
Title:	Phase IA Cultural Resources Survey, Laurence Harbor Interceptor, Old Bridge Township, Middlesex County, New Jersey
Location:	Old Bridge Township, Middlesex County, New Jersey
Drainage Basin:	Marquis Creek, Raritan Bay, Atlantic Ocean
U.S.G.S. Quad:	Keyport, NJ
Project:	Interceptor Sewer
Level of Survey:	Phase IA
Cultural Resources:	High Sensitivity for Prehistoric Archaeological Resources; Moderate Sensitivity for Historic Archaeological Resources